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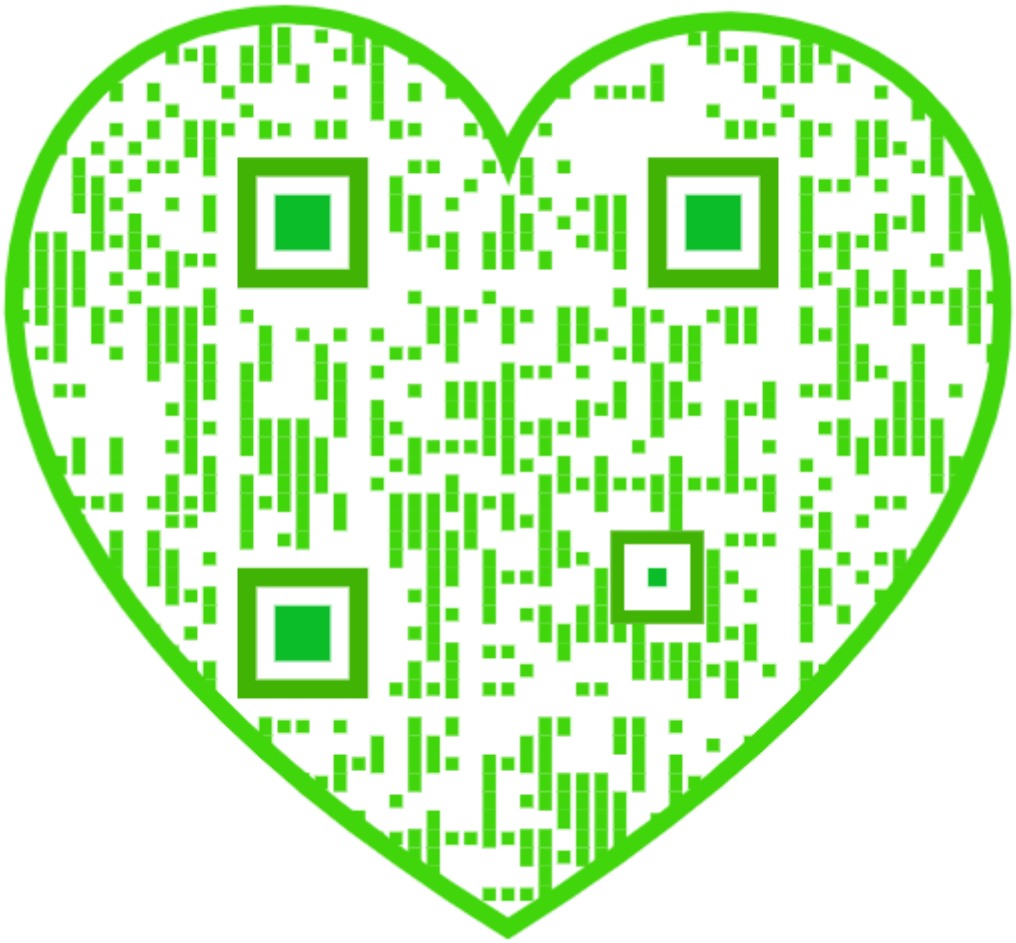
COCAINE

AND ITS USE IN OPHTHALMIC AND GENERAL SURGERY

KNAPP



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COCAINE

AND

ITS USE IN OPHTHALMIC AND GENERAL SURGERY

BY

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WITH SUPPLEMENTARY CONTRIBUTIONS BY

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ON COCAINE AND ITS USE IN OPHTHALMIC AND GENERAL SURGERY.

By H. KNAPP.

NO modern remedy has been received by the profession with such general enthusiasm, none has become so rapidly popular, and scarcely any one has shown so extensive a field of useful application as cocaine, the local anæsthetic recently introduced by Dr. C. Koller, of Vienna. Convinced that it will not only continue to prove as valuable as it has hitherto been found, but that its properties will be the subject of numerous scientific researches and clinical observations all over the globe for many years to come, I purpose, as far as I am able, to collect in the following pages what knowledge has thus far been acquired on this highly interesting and important drug. To help the reader in gathering information is, however, not the only object of this paper; I would like it also to act as a stimulus for new investigations. From this standpoint I consider a faithful, unabridged translation of the original paper which Dr. Koller read before the Medical Society of Vienna, and published in the *Wien. med. Wochenschr.*, Oct. 25, and Nov. 1, 1884, not only as an acknowledgment of a debt of gratitude we all owe to him, but also as an appropriate introduction to the present article. The paper is as follows:

ON THE USE OF COCAINE TO ANÆSTHETIZE THE EYE.

By Dr. KARL KOLLER, Assistant Physician to the General Hospital in Vienna.
(Translated by H. Knapp.)

I want to report on some experiments which I have made in regard to anæsthetizing the eye. This is not my

first communication on this subject—a previous one, to secure priority, having been directed to the meeting of German oculists held at Heidelberg Sept. 15th and 16th of this year. Dr. Brettauer, of Trieste, was kind enough to deliver my paper to the Publishing Committee, and to exhibit before the Society my experiments, which have since been repeated and confirmed in different places of Germany.

It is generally known that cocaine, the alkaloid separated from the leaves of erythroxylon coca, in 1859, by Niemann, a pupil of Wöhler, possesses the remarkable property of rendering, on local application, the tip of the tongue anæsthetic. This property was discovered by Prof. Schroff, who first, in 1862, mentioned it before this Society. It is further known that cocaine, through the circulation, contracts the peripheric arteries, and it is known also that it dilates the pupil both through the circulation and on local application. From the foregoing it is evident that cocaine has been instilled into the eye in former years, but those phenomena have been overlooked which will be the subject of my present communication.

The internal application of cocaine, tried repeatedly, has always been abandoned again. In 1880 Dr. von Anrep [1] published an elaborate experimental paper on cocaine, at the end of which he points out that its local anæsthetic action may become of importance. To us Viennese physicians cocaine has been prominently brought to our notice by the thorough compilation and the interesting therapeutic paper of my colleague at the General Hospital, Dr. Sigmund Freud.[2] Starting from the supposition that a substance paralyzing the sensitive terminations of the mucous membrane of the tongue could not greatly differ in its action on the cornea and conjunctiva, I have made, in the laboratory of Prof. Stricker, a number of experiments on animals, of which, in brief, the following were the results obtained:

A few drops of a watery solution of muriate of cocaine; [3]

[1] *Pflüger's Archiv f. d. ges. Physiol.*, 21. Bd.

[2] *Centralbl. f. Therapie v. Heitler*, August number, 1884.

[3] Muriate of cocaine dissolves up to 5 % in water without addition of an acid, but always opalescent. Addition of acids is to be avoided, as a very small quantity of acid causes intense burning. The opalescent solution becomes as clear as water by filtration.

LIBR

dropped on the cornea of a guinea-pig, rabbit, or dog, or instilled into the conjunctival sac in the ordinary way, cause for a short time winking of the eyelids, evidently in consequence of a slight irritation. After one half to one minute the animal again opens its eyes, which gradually assume a staring look. If now the cornea is touched with a pin-head (in which experiment we have carefully to avoid touching the eyelashes), the lids are not closed by reflex, the eyeball does not move, the head is not drawn back as usual, the animal remains perfectly quiet, and on application of stronger irritastion we can convince ourselves of the *complete anæsthesia of the cornea and conjunctiva*. In this way I have scratched and transfixed the corneæ of my animals used for experiment with needles, and have excited them with electric currents so strong as to cause pain in my fingers and become quite intolerable in the tongue; I have cauterized the cornea with the nitrate-of-silver stick until it became milky-white—during all this the animals did not move. The last experiment convinced me that the anæsthesia involved the whole thickness of the cornea, and did not affect the surface only. But if I incised the cornea, the animals manifested intense pain when the aqueous humor escaped and the iris prolapsed. I have been unable, hitherto, to decide by experiments on animals whether or not the iris could be anæsthetized by dropping the solution into the corneal wound, or by prolonged instillations into the conjunctival sac; for experiments to test the sensibility of non-narcotized animals are very complicated and difficult, and do not yield unambiguous results. The last question which I subjected to experimentation on animals, viz., whether or not the inflamed cornea could be anæsthetized by cocaine, was answered in the affirmative. The cornea in which I had incited a foreign-body keratitis became as insensible as a healthy one.

Complete anæsthesia of the cornea from the use of a 2 % solution lasts ten minutes on an average. After such successful experiments on animals I did not hesitate to apply cocaine also to the human eye, trying it first on myself and some of my friends, then on a great number of other

persons, obtaining without exception the result of a perfect anæsthesia of the cornea and conjunctiva. The course of the phenomena is as follows: If some drops of a 2% solution are instilled into the conjunctival sac, or better still, let run over the cornea, first a slight burning (accompanied by some lachrymation) is felt, which in one half to one minute disappears, being followed by a dull sensation of dryness. The eye, like that of the animals mentioned above, assumes a staring look, owing to a *considerable dilatation of the palpebral fissure*, a phenomenon to the explanation of which I shall return later on. If now the cornea is touched with the head of a pin, no sensation of *pain*, or of *contact* is experienced, and all *reflexes* are absent. The same holds of the conjunctiva, in which the sensation of *temperature* is likewise abolished. The scleral conjunctiva can be grasped with a pair of toothed forceps, or a dimple can be made into the cornea by pressure, without any unpleasant sensation or the least reflex on the part of the person thus treated; the only thing he perceives is an indistinctness of objects, owing, of course, to the change in the curvature of the cornea. This complete anæsthesia lasts from seven to ten minutes, then passes through a longer stage of reduced sensibility into the normal condition. About fifteen or twenty minutes after the instillation the pupil begins to dilate. The dilatation reaches its highest degree within the first hour, decreases considerably in the second hour, and disappears without a trace in a few hours more. The pupil is never *ad maximum* dilated, responds promptly to light and convergence during the whole time, and for that reason the sensation of dazzling, connected with atropine mydriasis, is either totally absent or only slightly pronounced.

A very insignificant paresis of accommodation appears and disappears with the mydriasis; the near point receded $\frac{1}{2}''$ in myself and another person whom I examined on this point.

Furthermore I have observed a marked *ischæmia* in the normal, especially the palpebral, conjunctiva, on the duration of which I am unable to make any definite statement. Other not perfectly ascertained observations, such, for in-

stance, as the ophthalmoscopic condition, I will pass by for the present, yet I want to say that I have never noticed any *symptoms of irritation* from the use of cocaine.

As to the dilatation of the palpebral fissure, this phenomenon at all events precedes the action of cocaine on the muscles of the iris and the ciliary ligament. On account of its almost simultaneous occurrence with the anæsthesia of the cornea and conjunctiva, I have thought it to be in connection with this anæsthesia, accounting for it by the omission of the excitations which in the normal state act upon cornea and conjunctiva, and upon which the ordinary width of the palpebral fissure depends.

In regard to the anæsthesia I should not omit to mention some points of practical interest.

1. The anæsthetic effect of cocaine may be cumulated up to a certain limit, namely: if at the decrease of the anæsthesia cocaine is instilled anew, a second anæsthesia is obtained lasting longer than the first. In this way, by instillations every five minutes for a longer time, I have produced complete anæsthesia of from fifteen to twenty minutes duration.

2. The anæsthesia is chiefly a local one, *i. e.*, it is most intense in those places which have been in contact with the solution directly and longest.

3. As it can be demonstrated that cocaine is absorbed, and that from each instillation a certain, though small, quantity penetrates into the interior of the eye, first of all into the anterior chamber, it could *a priori* be expected that the deeper structures of the eye might be anæsthetized if they could be reached by sufficient quantities of the remedy. But as the absorption requires a certain time, and the anæsthesia of the cornea is of short duration, the anæsthesia of the cornea will have disappeared before the iris and ciliary body are acted upon. We must therefore anæsthetize the cornea again. Both demands can be satisfied by successive applications. By instillations of a 5 % solution made every five minutes and continued for about half an hour, I have succeeded in ascertaining an action upon the deeper parts of the globe, inasmuch as its sensibility on stronger pressure was essentially diminished.

I am indebted to the liberality of Dr. v. Reuss, acting surgeon of the clinic of the late Professor v. Jäger, for the opportunity of testing, during the last two or three weeks, the action of cocaine on diseased eyes.

From the beginning I have thought that therapeutically cocaine might be used in two directions: first, as a *narcotic* in *painful affections, of the eye*, and secondly, as an *anæsthetic* in *operations on the eye*.

In regard to the first category I have expected a good deal of benefit from its action in *diseases* of the *cornea* and *conjunctiva* accompanied by *pain* and *photophobia*. I have used cocaine in a greater number of patients suffering from lymphatic (phlyctenular) conjunctivitis with eruptions and ulcers of the cornea, and a 2 % solution in one patient affected with frenulum vasculare (from successive phlyctenulæ). All patients thus treated have said that a few minutes after the instillations they have *felt* materially better, pain and photophobia having considerably diminished. With the same unanimity, however, they have complained that two or three hours after the instillation pain and photophobia have returned. It might therefore be expected that by applications repeated at such intervals pain and photophobia could permanently be removed or at least abated. This mode of application has not yet been tried. Under the conditions to which I have limited my experiments I have not noticed any influence on morbid processes either in the one or the other direction.

With similar result I have used cocaine in a man with painful *erosion at the sclero-corneal junction*.

I should think that cocaine might exert its influence also on the *pain in iritis*, for I believe to have demonstrated that its anæsthetic effect extends in a certain degree to the iris and ciliary body. The mydriatic effect, on account of its insignificance, would not merit great consideration, but we may expect some influence from its property of contracting the blood-vessels. The combination with atropine treatment may, perhaps, be of advantage. I have not yet had an opportunity to try it in this disease.

The sensation of pain from cauterizing the lids with ni-

trate of silver can, by previous instillation of cocaine, either be entirely suppressed or at least materially weakened. The majority of the patients in whom this treatment has been tried, have alleged to have felt no pain at all; in others the pain, after a period of latency, has reappeared, but could be suppressed again by a repeated instillation. One patient said the pain had been much less severe, but had lasted longer.

On the utility of cocaine in the bluestone treatment my observations are few in number and contradictory; at any rate it should here be used much more freely than in touchings with nitrate of silver in solution.

I come to the second category of the use of cocaine, viz.: as an *anæsthetic in operations on the eye.*

It does excellent service in the *removal of foreign bodies from and out of the cornea*, often a difficult task on account of the restlessness of the patient. In a large number of such patients (about thirty) I produced the anæsthesia by letting two drops of a two-per-cent. solution run over the cornea while the patient was looking down. The instillation was repeated in from three to five minutes. All these patients have asserted to have lost the sensation of a foreign body; they held their eyes entirely quiet while the foreign body was dug out of the cornea with a needle, and, on being asked what they had felt, all have answered they had felt nothing at all.

With the same good result cocaine has been used in a case of *tattooing corneal scars*, and in an *operation for pterygium.*

Good results may be expected from cocaine in *cauterization of corneal ulcers* with the glowing iron, in paracentesis of the cornea, and in discision of cataract. Both the latter operations, as I have noticed in experiments on animals, and also in man, can be made absolutely without pain, for they consist only in fixing the conjunctiva and puncturing the cornea.

Dr. v. Reuss has performed *staphyloma operation* in a boy of ten and a girl of seven years without narcosis, but only by the use of cocaine after the method to be described presently. The children have kept perfectly still, and, according to their own statement, have experienced no pain.

Dr. v. Reuss was further kind enough to allow me to use cocaine in eyes on which he was to perform *iridectomies* and *extractions of cataract.* On the whole, I would like to say only that all these cases ran their *course without irritation*, a fact which certainly encourages to further trials. The experiments yielded more or less favorable results, but always corresponding to the intensity and manner in which the remedy was applied. The most favorable, as to painlessness during the operation, indeed almost entirely satisfactory, results were obtained in those cases in which the following method was strictly pursued: During half an hour immediately before the operation, two drops of a five-per-cent solution were instilled every five minutes. The head of the patient lies horizontal, and while he looks toward his feet, his upper eyelid is raised and the solution dropped on the upper part of the sclerotic.

One of the patients thus treated, a woman, on whom an extraction of cataract was performed, stated, on being questioned at the different steps of the operation, that she felt nothing at all of the corneal section; she did feel it when the iris was seized and drawn out, but it pained her only a little. There was no reaction during any of the steps of the operation; the same was the case with a weak-minded woman on whom the same operation was performed, which Dr. v. Reuss had dreaded on account of her great sensitiveness.

The following case seems to me remarkable on account of its peculiar conditions:

A man with seclusion of the pupil on both sides underwent an iridectomy on the left eye after cocaine application. There was not the least reaction during the operation, and he said that he had not felt at all the corneo-sclcral section (with the lance); he had felt the seizing and drawing out of the iris, but it had not given him any pain. A week later the same man was operated on the other eye, the cocaine this time being omitted. He pressed and squeezed in such a way that he rendered the operation quite difficult, as Dr. v. Reuss told me afterward.

Even if the majority of the patients that have to undergo such operations are torpid, persons who patiently bear their

pain, yet the last case seems to demonstrate that also in such cases an anæsthetic may be of great service.

AMERICAN CONTRIBUTIONS.

Two weeks before the original of Dr. Koller's paper was published in Vienna, American physicians were informed of its substance. Merck's muriate of cocaine being in the New York market, they without delay tried the new anæsthetic in every direction, finding for themselves a number of important facts before Dr. Koller's or other European publications reached them. This occurred in the following way:

Dr. Hy. D. Noyes, of New York, travelling in Europe, sent to the *Med. Rec.* a letter, published in that journal on Oct. 11, 1884, under the title: "A few cursory notes on the proceedings of the meeting of the German Ophthalmological Society, held at Heidelberg in the middle of September of this year." One of his notes at once attracted the greatest attention among the oculists of New York, and I dare say those of the whole country. It was "the extraordinary *anæsthetic* power which a two-per-cent. solution of muriate of cocaine has upon the cornea and conjunctiva when it is dropped into the eye." The cornea and conjunctiva can be touched and rubbed with a probe, a speculum inserted, the conjunctiva grasped with a pair of fixing forceps, and the eye pulled in different directions without any unpleasant sensation. "The solution causes no irritation of any kind, and its effect disappears in fifteen to thirty minutes." Its remarkable anæsthetic property was discovered by a young physician, Dr. CARL KOLLER, Secundararzt at the General Hospital of Vienna, only a few weeks before its presentation at the Heidelberg Ophthalmological Congress through Dr. Brettauer. "Dr. Koller had made but few trials with it. These he had been led to make from his knowledge of the entirely similar effect which it has, for some years or more, been shown to have over the sensibility of the mucous membrane of the *mouth*, *pharynx*, and *larynx*. The substance makes a clear solution, and is found in Merck's catalogue."

A short communication on the same subject is published in a report of the same meeting by the *Ophthalmic Review* (London, October, 1884, p. 316). It adds to the account of Dr. Noyes only the following statement: "The drug causes a slight *mydriasis*, which lasts a couple of hours, and is accompanied by *some paresis of accommodation, but reaction to light and eserine is not obliterated.*"

A third communication is found in No. 39 of the *Wiener med. Wochenschr.*, Sept. 29th, p. 1175, as follows: "Referring to Dr. Koller's communication to the Heidelberg Ophthal. Congress, Dr. EDMUND JELLINCK informs us that he had noticed a similar anæsthetic and *analgesic* effect when a cocaine solution was brushed over the mucous membrane of the pharynx and larynx. A detailed account will be given when both experiments are concluded."

The above is all that has come to my knowledge on cocaine, from European sources until Nov. 25th, when Dr. Koller's original publication in the *Wien. med. Woch.* of Oct. 25th reached me.

The first American contributions are short notes contained in the *Med. Record* of Oct. 18th, p. 438 by Drs. C. R. AGNEW, W. O. MOORE, and J. L. MINOR, concerning the application of cocaine to eye-patients. AGNEW reports on two *squint* operations that had been done without pain under cocaine; on a case of *injury* to the eye, where the remedy had in a few minutes relieved great *irritability* and *blepharospasm;* and on another where the extreme *sensitiveness* to the touch was so reduced by the remedy, that in two and a half minutes the patient permitted his sclera to be touched with the finger without wincing. MOORE used it in a case of a *corneal ulcer* "which was touched and gently scraped without sensation"; further in an operation for *pterygium*, which was done with the utmost ease and without any painful sensation; then for *squint* in a boy, æt. seven, who "made no complaint of pain, and simply said that the speculum stretched the lids, but was painless." MINOR used it *to remove the sutures* after a strabotomy which had been done three days previously. The speculum was introduced and the stitches taken off without pain. The patient

was a boy of ten years. He used it further in an exceedingly excitable lady, who had a *cataract extracted* easily and without pain. She said that she had not been hurt.

The number of the *Med. Rec.* of Oct. 25th (issued Oct. 24th) contains a paper on cocaine by myself, and one by Dr. D. B. St. JOHN ROOSA. Roosa used it in four operations of strabismus, the pain being greatly reduced; in a third case the patient experienced considerable pain, and said she would take ether the next time. He used it locally upon the membrana tympani, in one case of that rare disease, *tympanic neuralgia*. The patient said the pain was relieved in ten minutes after two instillations.

In MY OWN paper I first gave some pharmacological notes about cocaine, indicating the literary sources from which they were taken. I will only mention here that the first to isolate an alkaloid from the coca leaves was Gaedcke, who gave it the name *erythroxiline*, in 1855. Niemann and Lossen investigated it more thoroughly in 1860 and '62; Lossen analyzed it and found for it the formula: $C_{17}H_{21}NO_4$. I made experiments with cocaine on all accessible mucous membranes, except that of the vagina and uterus. *In the eye* I found that it produced neither pain nor any discomfort. The movements of the globe and the ophthalmoscopic condition remain unchanged. The tension in healthy eyes is either unchanged or slightly diminished.

"The *diminution of sensibility in the cornea and conjunctiva* varies in different individuals. In most cases it becomes manifest as early as two or three minutes after the first instillation, increases for ten to twenty minutes, then decreases and is over in about half an hour. When another instillation is made, ten to twenty minutes after the first, the anæsthesia is more intense, on superficial touching mostly absolute, and lasts longer. In an hour after the first instillation it becomes very feeble and disappears in one hour and a half.

"The *pupil begins to dilate* ten to twenty minutes after the first instillation, increases slowly for ten to forty minutes, scarcely ever becomes as large as with atropia (*maximum dilatation*), feebly responds to changes of light, remains stationary for about thirty minutes, and then the dilation slowly disap-

pears. The last trace had disappeared on the next day only."

[To try whether cocaine could produce a maximum dilatation, I have instilled a 3 % solution into the eye of a child for one hour and forty minutes every five to ten minutes, and during the last ten minutes every two minutes. The pupil became very large, but contracted to a certain degree, when exposed to light. The reaction was slow and limited, but distinct and invariable during the time of experimentation, and some hours later.]

"The *range of accommodation is shortened* by recession of the near point from the eye, the far point not being appreciably influenced. The shortening of the range of accommodation in me and my son (15 years old) was equivalent to $\frac{1}{36}$ (1 D); in a lady of thirty-two it was somewhat more. Cocaine, therefore, reduces the accommodation, but does not paralyze it. It may be preferable to other mydriatics if we want to dilate the pupil for ophthalmoscopic examinations of the interior of the eye, but it will probably not be powerful enough for determinations of refraction. It is a mydriatic which, even in producing a considerable dilatation of the pupil, takes away only a fraction of the power of accommodation. The accommodation is restored much sooner than the normal size of the pupil. In $1\frac{1}{4}$ hours to $1\frac{1}{2}$ hours we could read again as easily as before, though our pupils were still enlarged.

"*Cauterization of a 'cocainized' conjunctiva.*—The conjunctiva of my right eye was a little congested, and at 10:30 P.M., while writing this communication, I dropped a drop of a four-per-cent. solution of hydrochlorate of cocaine on the inner surface of the lower lid. Fifteen minutes later I noticed that this inner surface had become pale, paler than that of the left eye, which had been the paler before. I dropped another drop in, holding my head back so that the whole conjunctiva was moistened by it. Then I painted, before a looking-glass, a good-sized camel's-hair brushful of a two-per-cent. solution (gr. x. ad $\bar{3}$ j.) of nitrate of silver into the eye, the lower lid being everted. I left the liquid in place about twenty seconds, then it began slightly to

smart, whereas immediately after the application I only felt the cold, no pain. I washed the nitrate of silver away with ordinary water, and put another drop of cocaine in. This relieved the smart for five minutes, then it returned, but very slightly; a serous liquid ran from my right nostril, just as it does when a stronger solution of nitrate of silver is put in the eye in the ordinary way. I instilled another drop of cocaine and continued writing. In a quarter of an hour the eye felt hot and somewhat painful. The conjunctiva of the lower lid was moderately, that of the adjacent scleral conjunctiva slightly, red, and along the whole lower fornix lay a white streak of mucus. The cornea and upper scleral and palpebral conjunctiva were white as if nothing had been done. The pupil was wide, and the accommodation somewhat weakened, not so much as to make writing unpleasant, though the other eye had been 'cocainized' in the afternoon of the same day."

EXPERIMENTS ON THE EFFECT OF COCAINE ON OTHER MUCOUS MEMBRANES.

"1. **The ear.**—I have made only one experiment in this locality. It was an almost painless removal of polypoid granulations. I do not doubt that the remedy will find here a large field of application, both to allay pain and to render the parts insensible during operations in this exceedingly sensitive cavity. [In cases of perforation of the drumhead I noticed that cocaine anæsthetizes the mucous membrane of the drum cavity, but not the drumhead.]

"2. **The mouth.**—I can confirm the former observations that the tongue and the soft palate become numb. I sprayed and brushed my soft palate; in ten minutes I could pass instruments over it without pain or reflex phenomena, retching, etc. I brushed a four-per-cent. solution over the right half of my tongue from the tip to the base, held the tongue depressed with my finger and immovable as long as I could endure it. In seven minutes I repeated the manipulation; five minutes later the right side of the tongue and corresponding lip felt numb. Gentle touching was not perceived, but quite well on the other side. Then

I put, with a fine brush, some powdered sugar on the insensible parts, successively from the tip to the neighborhood of the palate. It was not perceived, whereas when put in the same way on the corresponding places of the other half of the tongue, it was at once tasted. The same was the case when common salt and a one-per-cent. solution of sulphate of quinine were placed on the tongue. In half an hour all was normal again. Conclusion: *Cocaine temporarily and locally destroys not only the sensibility and reflex mobility of the tongue and pharynx, but also the faculty of taste.* In the endeavor to suspend the sense of taste altogether, I sprayed my mouth and palate. The taste was much reduced, but not abolished, evidently because the remedy in this experiment had not sufficiently acted on all the portions of surface from which impressions of taste are received.

"3. **The nose.**—I brushed and sprayed the nose to test the action of the new remedy on the organ of smell. The experiments required a good deal of time and material before they were successful. The lower parts of the nose soon had a numb feeling and were insensitive on touching, but the power of smell was preserved. Bearing in mind that olfaction is the function of the upper nasal passages, the recesses of which are very difficult of access, I bent my head down so as to make the vertex its lowest part, and introduced the bent nozzle of a Richardson atomizer in such a way that the spray was directed from the lower to the middle and upper nasal passages, and the liquid flowed also in the same direction. This manœuvre had to be repeated three times before the faculty of smell was destroyed. Perfumes of rose and heliotrope were not perceived. Tincture of iodine, concentrated nitric acid, etc., produced no peculiar sensation, whereas on the other side they felt very unpleasant and produced coughing. *Cocaine*, therefore, *temporarily renders the mucous membrane of the nose insensible and destoys the sense of smell.* In less than half an hour the whole effect of the remedy had vanished.

"4. **The larynx and trachea.**—I am just suffering from an attack of acute bronchitis, with fits of troublesome cough-

ing in the morning and evening. When one of these fits came in the evening, I sprayed my larynx with cocaine and inhaled it as well as I could by means of a Richardson apparatus. The irritation was at once allayed, and soon subsided. I had no cough, but half an hour later I threw out, free from irritation, a large, compact, muco-purulent sputum. If this experiment should be confirmed by others, and the effect be the same or similar, cocaine will prove a great boon to patients with pulmonary difficulties. The perfected methods of introducing medicated substances by means of the ingenious apparatuses of Dr. Sass would relieve the distress of coughing and its prejudicial consequences. I may add, however, that the Richardson apparatus, which seems inadequate for this purpose, relieved me only partially in a second, and not at all in a third, attack during the night.

"5. **The urethra.**—My urethra is very sensitive to the introduction of instruments. I injected, by means of an Eustachian catheter and a balloon, a four-per-cent. solution of cocaine, and held it in for a few minutes. In ten minutes the glans had become pale and insensitive on touching. I repeated the injection. Seven minutes later I introduced a catheter and other instruments into the urethra. I did not feel them at all as far as 3″; when pushed farther I felt them very unpleasantly painful. Evidently the cocaine had not penetrated more deeply. Before the injection of cocaine I felt the instruments very keenly from the beginning of the urethra. To test the loss of sensibility of the cocainized urethra in another direction, I injected a one-per-cent. solution (gr. v. ad ℥ j.) of arg. nitr. into the anterior part by means of an Anel's syringe, introduced as far as 1½″. I had no sensation from it at all. In about thirty seconds I passed water, which caused a slight burning, disappearing in about a minute. Since that time I have not felt any thing from the treatment of my urethra. This experiment shows, and I feel convinced, that cocaine will prove most beneficial in uro-genital surgery. It not only destroys the sensibility of the parts, and therefore admits of the easy performance of many surgical procedures, but by being painless these

procedures will not incite reflex phenomena, spasm, and the like.

"6. **The rectum.**—For the sake of completeness I injected cocaine also into the rectum. The sensibility, which was not great anyhow, was reduced."

I have taken the liberty to reprint the above experiments from the *Medical Record* (Oct. 25th), because some of them were new—*e. g.*, those on the urethra, the rectum, and the upper nasal passages.

The remainder of my paper contains the description of the application of cocaine in nine patients: squint, foreign body, pterygium, cataract-extraction, tumor sacci lacrymalis, polypi auris, in all of which the anæsthetic effect of cocaine was evident. In two cases of *old trachoma* the following is said: "Insensibility of cornea and conjunctiva; touched with sulphate of copper. No pain, no irritation, scarcely any increased congestion after the application. No discomfort as when touched before."

The *N. Y. Med. Journ.* of Oct. 25th, pp. 459–461, contains two papers on cocaine. The first is a short report of Dr. Leroy P. Walker, resident surgeon of the N. Y. Eye and Ear Infirmary, on fourteen cases treated with cocaine by Dr. W. F. MITTENDORF. These were: Three cases of squint, operated on without pain; three cases of *discision of cataract*, two primary, one secondary; all without pain. One *iridectomy;* no pain. Four cases of foreign body imbedded in the cornea; removed absolutely without pain. One of *burn* of cornea and conjunctiva with hot metal; pain of eye removed. One case of injury by a fragment of metal. Great *pain*, *photophobia*, and *lachrymation* removed by cocaine—ten drops insilled twice in five minutes. One case of painful corneal ulcer after contusion; relief by cocaine during thirty-six hours. Ulcer healed by this time.

The paper concludes with saying: "In five cases of *sensitive throat* I have been enabled not only to use the mirror, but to prick the mucous membrane with a sharp-pointed instrument without pain and with very little 'gagging.'"

The second paper is a report of cases from Dr. E. GRÜNING'S practice by Dr. J. H. Claiborne, Jr. In extraction of

cataract from both eyes at the same sitting, only the iridectomy caused pain. In an iridectomy for *degenerated glaucoma*, the corneal section was attended with no pain, the iridectomy with pain. A foreign body was removed from the cornea without pain, and *massage* in a case of *episcleritis* was less painful under cocaine than before.

Dr. D. C. COCKS, of New York, published in *Med. News*, Oct. 25, 1884, p. 455, several cases in which he found cocaine anæsthesia of use, viz.: 2 of *foreign bodies* of the cornea; 2 of *quint*; 1 of *tattooing* of the cornea. It allayed the pain in a case in which the cornea was *scratched by an infant's nail*, but not in another in which the cornea and conjunctiva were *burnt* with a red-hot piece of iron.

Dr. E. S. PECK, New York, (*Med. Rec.*, Nov. 1, 1884, p. 494,) used cocaine suceessfully in *stitching a lacerated wound of the eyelid*, "cutting through the conjunctiva, the tarsal margin, and the integument. A stitch in the conjunctiva and two in the integument were taken after six instillations of a 4 % solution, covering 25 minutes. Patient experienced no pain, either from the forceps or needles, and stated that the sensation had been as if something had been pressed against the parts involved."

Dr. W. H. POLK, of New York, introduced the new anæsthetic into operative *gynæcology*. November 1, 1884, he published (*Med. Rec.*, p. 489) two cases of trachelorrhaphy. After thorough cleansing and drying of the parts, a 4 % solution was painted over the cervix, in the canal, and over the adjacent vaginal wall with a camel's-hair brush. This was repeated twice at intervals of two to three minutes. Within three minutes of the last application the operation was begun. It required the removal of extensive pieces of cicatricial tissue. The operations lasted 40 minutes. The patient suffered no pain until the last 10 minutes, then she spoke of her discomfort as being a sense of soreness rather than of pain.

In the second case no pain was felt till the lapse of about 20 minutes, then it was so acute as to require an application of the solution of cocaine, making in her the fourth. It was made directly to the cut surfaces, which had first been freed

from blood. The operation was completed in three minutes without any further pain.

The drug seemed not only to blunt sensibility, but retard the first appearance of blood on the cut surfaces.

Dr. E. GRÜNING, of New York, communicates (*N. Y. Med. Jour.*, Nov. 1st, p. 488), through the pen of Dr. Claiborne, "more clinical facts regarding the hydrochlorate of cocaine," from his hospital and private practice. They consist in two iridectomies (for artificial ripening of cataract), one strabotomy, one pterygium operation, and the two following cases:

1. Advancement of the external rectus. "Exposure of the muscle, tenotomy, and insertion and tying of the sutures were attended with considerable pain."

2. Hypertrophy of the mucous membrane covering the inferior turbinated bone. "Eighteen drops of a 2 % solution were instilled into the inferior meatus, and as nearly as possible on the mucous membrane of the inferior turbinated bone. Six drops were instilled every three minutes. A few minutes after the last instillation, the actual cautery was applied," and caused no pain.

The article ends with the following remark, which is of interest: "Considering the high price of cocaine, it has been suggested to the minds of many that its cheaper sister alkaloids—caffeine, theine, theobromine, and guaranine—might be possessed of similar anæsthetic properties. As there are no stable single salts of these alkaloids, extensive experimentation has been made by Dr. Grüning with the double salts, the salicylate of sodium ($2\frac{1}{2}$ %) and caffeine (4 %), and the benzoate of sodium and caffeine (4 % each) in watery solution. In no case, however, has he obtained any anæsthetic effect with either."

The *Boston Med. and Surg. Journal* of Nov. 6, 1884, contains two papers on cocaine; the second, by C. H. WILLIAMS, confirming the anæsthetic effects of cocaine in several operations; the first, entitled "Rapid Cocainization," by H. W. BRADFORD, containing a number of valuable new observations and suggestions.

In a case of incised wound in the ciliary region, the *pro-*

lapsed iris, after the third instillation, in the twelfth minute, was seized with forceps and snipped with scissors, the patient not feeling the slightest pain.

Traumatic *ulcer of the cornea with hypopyon;* 2 % solution; 12 minutes. Upon the introduction of the iris forceps to dilate the opening into the anterior chamber, slight pain was complained of, which was not experienced after placing a drop along the line of incision. The usual pain due to evacuation of the aqueous was not noticed.

In the following nine operations, Bradford used an 8 % solution, of which one drop was instilled every minute. The anæsthesia was complete in between two and five minutes. In *strabotomy* the conjunctiva was seized with forceps at the end of the second minute, cut and dissected up, and one drop placed near the site of the muscle, which was then divided. The patient said the operation was in no way painful.

In a case of *cataract*, the speculum was inserted at the end of the third minute. At the end of the fourth minute one drop was placed upon the corneal incision, and half a minute later the iris was seized, drawn out, and divided, the patient complaining only of a slight twinge of pain. The hemorrhage from the iridectomy was very slight and transient, being in marked contrast to an iridectomy under ether.

"There has been thus far in this line of cases no bad results noticed." Dr. Bradford thinks that there may be a method of rapid cocainization, provided a sufficiently strong solution is used and the intervals between the successive instillations are sufficiently short.

Dr. W. O. MOORE, *Mcd. Rec.*, Nov. 8, 1884, p. 511, adds some valuable observations to his former communication. In a case of iridectomy for *leucoma adhærens*, he injected, after the section, two drops of a 2 % solution through the corneal wound on the iris surface. The iris section proved to be painless, and the operation did well.

After the slitting of the canaliculus in a case *of stricture of the tear duct*, the conjunctiva having been anæsthetized by cocaine, an Anel's syringe, charged with eight drops of a 4 % *cocaine solution* was introduced into the cut canal, and

the fluid *forced into the nasal duct* as far as it would go. After waiting four minutes, the No. 8 probe was passed without pain down to the roof of the mouth; this was then removed and a lead wire introduced, the patient all the time having no sensation. In twenty minutes after the injection, the lead wire, having been purposely left, was felt for the first time.

In a case of *syphilitic iritis*, the *pain*, not influenced by atropine, was *relieved* by cocaine. It returned in the night, but not so severe.

In an *irritable stump* he used some twenty drops, with same benumbing influence, yet not sufficient to warrant the removal of the eye, which, after two minutes, was removed in the "old-fashioned" way.

In a strabotomy, he "dropped six to eight drops on the conjunctiva and injected six drops under the conjunctiva, over the site of the muscle. This procedure caused the pain to be entirely abolished. No bad after-effect occurred."

Dr. E. O. SHAKESPEARE, of Philadelphia, published (*Med. News*, Nov. 8, 1884, p. 508) a number of experiments on himself and patients—external inflammations, one iridectomy—confirming the physiological, anæsthetic, and analgesic action of cocaine.

Dr. F. H. BOSWORTH publishes a very important contribution: "A New Therapeutic Use for Cocaine," in the *Med. Rec.*, Nov. 15, '84, p. 533. When a two-per-cent solution is applied to the mucous membrane of the *nasal cavity*, by means of a pledget of cotton wrapped on a small probe, it produces in twenty or thirty seconds a very notable contraction in the venous sinuses, covering the lower and middle turbinated bones, expelling all the blood so that the membrane clings closely to the bony structures, which then become visible in absolute outline. Entire depletion of the sinuses of the whole cavity is accomplished in about three minutes, the production of anæsthesia, as a rule, requiring a longer time. Dr. Bosworth has used this property of cocaine to differentially distinguish *venous turgescence*, which is eliminated by the remedy, from *genuine hyperplasia*, which is not; further, cauterizing the mucous membrane

was rendered comparatively painless by the drug; in *acute coryza* the venous sinuses were completely emptied, and the nasal passages remained absolutely clear; in the *removal of nasal polypi* the swelling of the mucous membrane was reduced, a clear view into the upper regions of the nose was obtained, so that it became comparatively easy to recognize and remove even the smallest growths. In no case was there other than the most trivial bleeding. In two cases of *autumnal catarrh* there was complete relief from all the symptoms. He thinks that cocaine will control epistaxis from whatever cause.

Dr. N. J. HEPBURN publishes the results of hypodermic injections of cocaine, *Med. Rec.*, Nov. 15, '84, p. 534. Six minims of a two-per-cent. solution were *injected under the skin* of the arm; in four minutes complete anæsthesia of the skin eight lines in every direction from the centre of the injection. The injections were repeated every five minutes in adjacent spots until forty-eight minims had been used. By this time the general effects had been so marked that it was deemed unadvisable to continue the experiment. There were acceleration of pulse and respiration, an agreeable feeling of warmth, moderate mydriasis, slightly crossed diplopia, agreeable hallucinations with closed eyes, disappearing when the eyes were opened; impairment of cutaneous sensibility, a feeling as if walking on cushions, a tendency to walk on the heels, and a sensation, on grasping an object, as if something spongy were interposed. Two other experiments had the same results, but the number of six- and eight-minim injections could be carried on to sixteen before they had to be discontinued.

Dr. E. E. HOLT, of Portland, Maine, (*Boston Med. and Surg. Jour.*, Nov. 20, '84,) instilled one drop of a *one-per-cent. solution* into a cataractous eye thirteen times in the course of two minutes, then removed the cataract. "The eye was particularly unsound, since, when the counterpuncture was made, vitreous was seen to present, but by careful manipulation *no vitreous was lost*, and it is believed that the use of the drug assisted materially in preventing such a disaster.

Dr. E. R. SQUIBB (*N. Y. Med. Jour.*, Nov. 22, '84) states that he had received a letter from Dr. Noyes before the one which had appeared in the *Med. Rec.*, and that he had immediately sent some of the hydrochlorate of cocaine to Dr. C. S. Bull and another gentleman [Mathewson]. Dr. Bull was probably the first man in this city [and country] to employ the drug, which was on Oct. 8, '84. Dr. Bull has used it very extensively since. His first and, thus far, only publication is a very well-written paper, read before the N. Y. State Medical Association, Nov. 19, '84, and published in abstract in the *Med. Rec.* and the *N. Y. Med. Jour.*, of Nov. 22d, and in full in the *N. Y. Med. Jour.*, of Nov. 29th, p. 609. His physiological experiments confirm what has been made known by Koller and others. He has used the drug in more than 150 cases, and has succeeded in producing complete anæsthesia in all but three cases, while in these three cases the sensibility was decidedly diminished. In no case has he seen the pupil become so dilated as from atropine, even when a four-per-cent. solution has been used. In one case no dilatation of the pupil was produced after repeated instillation of the stronger solution, though atropine acted promptly on this patient.

As illustrations of the usefulness of cocaine in ophthalmic surgery he reports ten cases.

Abscess of cornea; cornea transversely split; no pain.

Kerato-iritis with hypopyon; broad paracentesis of cornea with lance-knife; pus evacuated without pain. *Squint;* conjunctiva opened, cocaine instilled beneath; five minutes later another instillation, then—ten minutes after opening the conjunctiva—tenotomy without pain. *Chronic glaucoma:* two drops of a two-per-cent. solution were dropped through the corneal wound into the anterior chamber, and in ten minutes a broad iridectomy was completed without the slightest sensation of pain.

A *cataract*, after a preliminary iridectomyy had been previously done, was extracted (peripheral incision, quadrilateral capsulotomy) with ease and entire absence of pain.

Retention *cyst* of the ocular conjunctiva. A two-per-cent. solution was instilled twice, and within ten minutes the cyst

was slit up, its contents evacuated with the spoon, and its inner surface cauterized with tincture of iodine—all painlessly.

Mucocele, with stricture of nasal duct. Instillation of cocaine four per cent. through lachrymal punctum, canaliculus slit, sac opened, contents evacuated; solution dropped into duct through opening in sac; in ten minutes the stricture thoroughly divided with Stilling's knife, and a large-sized Theobald's probe introduced—all painlessly.

"It may thus be seen that almost all the various operations on the eyeball and inner surface of the eyelids, and on the tear-passages may be performed painlessly under the anæsthetic influence of cocaine. The only operation in which it may not answer its purpose is that of enucleation.

He adds that he has performed *paracentesis of the membrana tympani* three times with entire absence of pain, has removed exuberant granulations from the depth of the ear-canal under cocaine without pain. He has used the solution in acute coryza, both nostrils being almost completely occluded, with such effect that in less than ten minutes both nostrils were entirely free, and remained so for about five hours. The swelling then returned, but to a less degree. The application was made through the nostrils with a probe and cotton, and through the mouth to the posterior nares with a brush.

Dr. F. M. WILSON, of Bridgeport, Conn., relates ("Cocaine Hydrochlorate in Minor Surgery," *Med. Rec.*, Nov. 22, '84) the painless removal of a small *fatty tumor upon the forehead* after subcutaneous injections of cocaine.

The *N. Y. Med. Jour.* of Nov. 22, '84, gives a report of the meeting of the Clinical Society of the N. Y. Post-Graduate Medical School and Hospital, held Nov. 8th. The subject for discussion was hydrochlorate of cocaine. Dr. GEO. B. HOPE reported the case of a *papilloma of the larynx* which had been made much easier by cocaine anæsthesia. Dr. A. H. SMITH related a similar case. The growth, twice the size of a coffee-bean, had resisted all former attempts on account of spasmodic closure of the glottis. Under cocaine a loop was introduced through the

glottis, passed around the neck of the tumor, and on drawing the wire home the growth was readily separated from its attachment and brought out entire. It would be difficult to imagine any thing more satisfactory than the effect of the cocaine in this case.

Dr. S. D. POWELL could dilate under cocaine *a deep urethral* stricture where the sensitiveness was so great that the introduction of even the softest instrument, without anæsthesia, was impossible.

Dr. H. G. LYTTLE reported a case of *internal urethrotomy* under cocaine. The penis became quite small, cold, and anæmic, especially the glans. No unpleasant after-effects were noticed from the use of the drug.

Dr. A. H. SMITH said that Dr. SHAW had used cocaine in *removing a toe-nail.* He had wrapped the toe for a few minutes in cotton saturated with cocaine solution, had then divided the nail and removed it without pain.

Dr. M. J. ROBERTS reported that Dr. Eddy, a dentist, had used it with success in *cutting-operations upon the gums*, but had not found it of any benefit when applied in sensitive teeth.

Dr. C. A. VON RAMDOHR had succeeded in making an *examination* in a case of *vaginismus*, which had always before resisted every attempt, by brushing the mucous membrane with some of the solution.

Dr. B. BETTMANN, of Chicago, (*N. Y. Med. Jour.*, Nov. 22, '84, and *Jour. Am. Med. Assoc.*, Nov. 22, '84,) *probed the tear-duct*, after having slit the canaliculus and injected cocaine.

In a case of severe *earache* from acute purulent otitis, a few drops of the solution instilled into the ear caused almost immediate cessation of pain, and the ear could be manipulated without the slighest annoyance to the patient.

Dr. J. BETTMANN, of Chicago, (*ibidem*,) reduced the swollen erectile tissue in the nose by galvano-cautery painlessly under cocaine in a case of reflex *asthma nervosum.*

Dr. C. F. CLARK, of Philadelphia (*Med. News*, Nov. 22, 1884,) performed a tenotomy of each internal rectus virtually without pain by dropping cocaine in the wounds as he proceeded. He noticed the ischæmia of the parts as a striking feature.

Dr. E. F. INGALS, of Chicago, (*Jour. Am. Med. Assoc.*, Nov. 22, '84, p. 572,) reports a number of cases in which cocaine was advantageously used for *various affections* of the *nose and throat*, *e. g.*, naso-pharyngeal fibroma, nasal polypi, swelling of turbinated body, hypertrophic catarrh, cystic tumor, etc.

Dr. C. J. LUNDY, of Detroit, publishes his experiments and experience with cocaine in the *Jour. of the Am. Med. Assoc.*, Nov. 22, '84, p. 575, and the Nov. number of the *Phys. and Surg.*, Ann Arbor, Mich. He used it in the ordinary operations on the eye, and besides in a case of enucleation, but before the operation was completed the patient complained of pain, and chloroform was given.

Dr. SAMUEL THEOBALD, of Baltimore, publishes among others the following cases (*Md. Med. Jour.*, Nov. 22, '84, p. 57). In an eye affected with *inflammatory glaucoma* the drug was probably very imperfectly absorbed, and the anæsthesia was incomplete. The operation nevertheless caused less pain than one performed previously on the other eye.

In a case of enucleation cocaine was instilled before and during the operation, getting, to some extent, under the conjunctiva. The section of the muscles and the division of the nerves of the eye were evidently attended by severe pain.

Dr. J. A. MICHAEL, of Baltimore, (*ibidem*, p. 59,) communicates the successful employment of cocaine in *venereal surgery*, *e. g.*, removal of venereal warts with broad bases, the operation of phimosis, incision of a contracted meatus with chronic gonorrhœa, of a suppurating bubo, cauterization of small ulcers with chloride of zinc. In all these cocaine had materially lessened the pain.

Under the head, "Hospital Reports," the same issue of the *Md. Med. Jour.* gives an enthusiastic account of the manifold applications of cocaine at the Presbyterian Eye, Ear, and Throat Hospital of Baltimore, by Dr. CHISOLM, without adding any thing new.

Dr. A. T. CABOT, of Boston, (*Bost. Med. and Surg. Jour.*, Nov. 27, '84, p. 515,) reports on the more or less painful operations of congenital *adhesions of the prepuce and urethral*

stricture under cocaine. Dr. F. I. KNIGHT used the drug in the form of spray in two operations for *laryngeal papilloma* without much effect on brushing a solution on the pharynx of a phthisical patient.

Dr. W. C. BURKE, of South Norwalk, Conn. (*N. Y. Med. Jour.*, Nov. 29. '84), injected cocaine under the skin of the hand, which was swollen and painful from a *shot*, the ball being situated near the first phalanx of the little finger. Neither the cut nor the subsequent manipulation in the removal of the ball gave any pain whatever.

Dr. G. T. JACKSON, of New York, (*N. Y. Med. Jour.*, Nov. 29, '84,) rubbed a *four-per-cent. ointment of cocaine and oleic acid* into the skin for about five minutes, and found that *epilation* and the removal of superfluous hairs from the upper lip and cheek of a female patient by electrolysis were done with slight or no pain.

The report of a novel and very neat application of cocaine in a case of *enucleation*, by Dr. C. S. TURNBULL, oculist to the German Hospital of Philadelphia, is contained in an editorial of the *Med. and Surg. Rep.*, Nov. 29, '84, p. 628. Two drops of a four-per-cent. solution of cocaine were instilled every three minutes until eight had been used. When Tenon's capsule was opened, one drop of the solution was allowed to flow into the cut. As each tendon was caught up with the hook, a drop fell upon it, and the successive tenotomies, each being preceded by a drop, were made at deliberate intervals. The large blunt-pointed scissors, curved on the flat, were next introduced from the nasal side, and with these in position, after thorough sponging, two or three large drops were so instilled as to flow down the blades, one on each side of the optic nerve as a guide. After waiting a minute the optic, and with it the ciliary nerves, were severed at one stroke, during which the patient remained entirely quiet. There was less than the usual bleeding, and the healing was undisturbed. Cocaine maintained its claims as an anæsthetic and hæmostatic.

Dr. G. M. LEFFERTS, of New York, (*Med. News* Nov. 29, '84, p. 597,) reports great relief of the *terrible dysphagia* in advanced laryngeal phthisis by cocaine. The parts were

first carefully cleansed by spray-applications of an alkaline solution, then immediately bathed gently, yet thoroughly, with a four-per-cent. solution by means of a large laryngeal brush. The effect was surprising. "A patient who was slowly perishing more from hunger and thirst than from disease, one application so anæsthetized the acute sensibility, that a full glass of milk was immediately drank with ease and entire comfort. Also the dyspnœa was notably relieved. In a large series of cases the results have always been the same."

Dr. W. C. DABNEY, of Charlotteville, Va. (*ibidem*, p. 613). Case of a boy who *struck* his *eye against hot iron.* Intense pain relieved by cocaine. Examination showed upper part of the cornea milky. Recovery.

Dr. R. J. LEVIS, of Philadelphia, publishes in the *College and Clinical Record*, Dec. 1, '84, p. 258, "notes on the use of cocaine," of which the following may be quoted: "Prior to the applying of nitric acid as a caustic to a syphilitic ulcer of the tongue, the tongue was wiped dry, held protruding between the teeth, and a four-per-cent. solution of cocaine was brushed on. No pain was produced by the caustic on the thoroughly anæsthetized tongue."

Dr. F. N. OTIS, of New York, publishes his experience in *genito-urinary surgery* in the *N. Y. Med. Jour.*, Dec. 6, '84, p. 635. He used it with the greatest advantage in cases of stricture, enlargement of the prostate, irritability of the urethra, stone in the bladder, and ulcer in the rectum. Cocaine made not only the examination painless and easy, but also operations and cauterizations. One remark may be of use for probing the lachrymal duct. He says: "A four-per-cent. solution of the hydrochlorate of cocaine in almond-oil makes an excellent lubricant for urethral instruments, and I think may prove even better than the watery solution for applications to the urethra. Its use in this way, in a few cases, has been very satisfactory."

Dr. R. J. HALL, of New York, communicates (*ibidem*, p. 643) a number of very important experiments. He and Dr. HALSTED injected a four-per-cent. solution of cocaine near or into several nerves, *e. g.*, the ulnar, musculo-cutaneous of

the leg, antero-superior dental, inferior dental, and lingual. They injected from six to thirty-two minims, and found that the tissues supplied by these nerves had become anæsthetic. There was no diminution of muscular power. The anæsthesia was complete until twenty-six minutes after the injection, and sensibility was much diminished for ten or fifteen minutes longer. The introduction of the needle into the ulnar nerve caused quite severe pain, with tingling down the little finger, but the injection gave rise to no sensation. From fifteen to thirty-two minims caused constitutional symptoms. "About six minutes after the injection there was giddiness, at first slight, then well-marked, so that I could not walk without staggering; and finally, there was quite severe nausea, the skin was covered with cold perspiration, and the pupils were dilated. The nausea passed off with the local anæsthesia in about twenty minutes, leaving some dizziness for an hour or so longer."

In a small congenital cyst over the outer third of the left supra-orbital ridge, nineteen minims of a four-per-cent. solution were given hypodermically in divided doses,—one external to the tumor, the others close to the supra-orbital notch. In about five minutes the anæsthesia was complete. The removal of the tumor, somewhat protracted, was connected with pain only at the last minutes.

"We have used this mode of administration successfully in a number of cases in the Roosevelt Hospital Out-Door Department, and it is obvious that, when the limits of safety have been determined, it may find a very wide application."

Dr. C. H. CASTLE of Cincinnati, reports (*Med. News*, Dec. 6, 1884, p. 662,) on Dr. Rob. Sattler's (Cincinnati) experience with cocaine, which is quite extensive and essentially confirmative of what is stated in the previous reports.

Dr. J. F. CROSTON, of Haverhill, Mass., removed an epithelioma (rodent ulcer) of the cheek under anæsthesia by cocaine, which had been injected underneath.—*Bost. Med. and Surg. Jour.*, Dec. 11, '84, p. 573.

Dr. W. C. JARVIS, of New York, (*Med. Rec.*, Dec. 13, '84, p. 654,) describes several cases of successful *intra-nasal opera-*

tions under cocaine anæsthesia, *e. g.*, removal of a horizontal ledge of deviated cartilage; firm, elastic, flesh-like masses filling the nostrils; hypertrophied turbinated tissue, and polypi. In some cases he began the operation with cocaine and ended it with freezing the parts by the spray of rhigolene, a petroleum naphtha, proposed by H. J. Bigelow, of Boston, as a local anæsthetic. (See "Dictionnaire de Médecine," etc., Littré and Robin.)

Dr. D. C. COCKS, of New York (*Med. News*, Dec. 13, 1884, p. 654), *anæsthetizes the iris* after the corneal section either by injecting the solution with a syringe, or let it run along a spatula introduced into the wound. In a few seconds the iris can be withdrawn and the cut painlessly made.

In performing an *enucleation* (Nov. 29th) he first anæthetized the cornea and conjunctiva in the ordinary way, then incised the conjunctiva on the temporal side, separated the subconjunctival tissue as far back as possible, and with an Anel's syringe injected a few drops of a 4 % solution over the tendon of the external rectus. He then divided this tendon, and introducing the point of the syringe as far back as possible, keeping its point near the globe, he injected a few more drops. This was done with each of the recti. The globe was then dislocated forward, the nerve severed, the obliques cut, and the conjunctival wound loosely drawn together with a stitch. The patient occasionally felt some pain, but not enough to interfere with the operation. The operation had lasted about half an hour, and during that time the solution was dropped on the eye, or injected into the orbit, every 3–5 minutes. About ʒ i ss., *i. e.*, 6 grammes, of a 4 % solution was used. Recovery undisturbed.

The PRESENT WRITER (*Med. Rev.*, p. 656) adds some new observations to his previous communication.

1. *Enucleation of an eyeball under anæsthesia from injecting cocaine into the post-ocular connective tissue.* The conjunctiva was first anæsthetized by instilling the solution. Then the globe was strongly drawn toward the nose by means of a forceps, and six minims of a 4 % solution (pain-

lessly) injected into the orbital tissue close to the posterior part of the globe. Five minutes later the eyeball was removed in the usual way. The divisions of the recti tendons caused slight pain; that of the optic nerve and the dissection of the posterior part of the globe, none or almost none. When the ball was removed, the branches of the toothed forceps were thrust an inch deep through the wound into the orbital tissue, of which the patient felt nothing. The bleeding was scant. Recovery undisturbed.

2. *Ptosis operation after subcutaneous injection of cocaine; anæsthetic effect not very satisfactory.* The tissue was suffused with blood along the track of the hypodermic needle, and the anæsthesia did not reach the upper limit of the region of the operation.

3. *Perforation of the drumhead; cocaine anæsthetizes the walls of the drum-cavity, but not the drumhead.*

4. *Cocaine in cataract operations pre-eminently useful.* Discisions are painless from beginning to end; in extractions only the grasping and drawing out of the iris are moderately painful. The anæsthesia and the temporary anæmia assist the operator in every step of the operation. No bad effect of cocainization on the result of the operation has been noticed; fifteen extractions up to time of writing, Dec. 2d, all doing well.

A week later the present writer *injected* five minims of a three-per-cent solution underneath a *sebaceous tumor* the size of a small walnut, situated in the centre of the *upper lid.* The anæsthesia was almost complete, and the somewhat laborious operation passed satisfactorily [and healed by first intention], but during it the patient [a strong man who never had fainted] became as pale as a corpse, felt somewhat faint, asked repeatedly for drink, and was covered with cold perspiration. In about fifteen minutes this condition of distress, which was, however, in no way alarming, disappeared. The writer sends this observation to the editor of the *Med. Record* as a *word of caution*, and adds that also the patient into whom he had injected cocaine prior to enucleation had become quite pale, but had shown no other unpleasant symptoms. The writer thinks

that injections into the orbit should be made with particular caution on account of the great vascularity of the tissue. In future cases he would begin with injecting no more than one or two drops and gradually feel his way.—(*Med. Rec.*, Dec. 13, 1884, p. 662.)

Dr. F. A. BURRALL (*ibidem*) recommends an alkaline *ointment of cocaine* hydrochlorate for piles.

Drs. G. W. WELD and C. H. SHEARS (*ibidem*, p. 657) have successfully used cocaine anæsthesia in *dental surgery* for removing tartar, extirpating exposed nerve-pulp, preparing sensitive teeth for filling by using the dental engine, etc., incising inflamed gums, and extracting teeth.

Dr. J. R. UHLER, of Baltimore, relates (*ibidem*) that cocaine when freely used upon the rectum, besides benumbing the parts, produced in two cases a rigid tonic *contraction* of the *sphincter ani* and the *longitudinal fibres of the gut*, pulling up the mucous membrane which had previously protruded.

Dr. J. W. STICKLER, of Orange, N. J., (*ibidem*,) publishes the results of injections of cocaine on himself. Once he felt a slight *muscular tremor*, but no other systemic disturbance. "It is interesting to observe that when the hypodermic needle is made to traverse a direct source through the skin and cellular tissue, the hydrochlorate of cocaine does not diffuse itself equally in every direction, but follows quite definitely the channel made for it by the needle, producing anæsthesia along this line, but only to a very limited extent on either side of it." [The writer has found this confirmed in the case of ptosis operation mentioned above.]

Dr. W. H. DOUGHTY, Jr., of Augusta, Ga., reports (*ibidem*, p. 658) a very successful performance of an operation for *vesico-vaginal fistula* under cocaine. There was no tenderness and but slight oozing of blood. When the sensitiveness and the bleeding reappeared, they were dispelled by new applications of cocaine.

Dr. EUGENE SMITH, of Detroit, Mich., (*ibidem*,) alleges that he obtains a more rapid effect from cocaine on the conjunctiva by applying it in the *form of spray* with a hand atomizer than by instillation. He produced total insensi-

bility of the iris in two cases of iridectomy by *injecting with a small lachrymal syringe two drops of a two-per-cent. solution into the anterior chamber.* Three minutes later the iris was seized and cut. *No reaction followed the intra-ocular use of cocaine.*

Dr. F. C. RILEY, of New York, (*ibidem,*) relates two cases (granular lids with intense pannus, perforating ulcer of cornea) in which repeated instillations of Merck's cocaine —which in other cases acted well—*failed to have any effect upon the sensibility of the conjunctiva and cornea.*

Dr. J. M. DA COSTA, of Philadelphia, delivered a lecture before the Philadelphia College of Physicians, December 3d, (published in the *Med. News*, Dec. 13, 1884, p. 651) on "Some observations on the use of hydrochlorate of cocaine, especially its hypodermic use," which contains several statements of importance.

A case of *earache*, which seemed to be neuralgic, was at once relieved by instilling a few drops of a 4 % solution into the meatus. A similar observation was made by the resident physician [name?] in the ward of his colleague, Dr. Hutchinson.

In one instance of neuralgia of the face in which the pain shot into the jaws, painting the gums of the upper jaw with a 4 % solution gave very speedy relief.

Dr. SQUIBB and Dr. JURIST have found that the strength of the solution, as we obtain it prepared, is less than indicated by the druggists, *e. g.*, a 4 % solution is in reality no more than a 3 % solution, owing to impurities, especially resinous substances, in the manufacture of Merck and others.

The most important result of hypodermic injections of about 0.03 grm., is that the pulse invariably becomes fuller and stronger. The vertical line of ascent in the sphygmographic tracing is twice as high as before the injection.

Dr. C. H. WILLIAMS, of Boston, (*Bost. Med. and Surg. Journ.*, Dec. 18, 1884, p. 585,) reports experiments on himself with cocaine subcutaneously, taking in the arm five one-half-grain doses at half-hour intervals. Anæsthesia a short distance up and down the arm and to a less distance around it was noticed.

Dr. O. F. WADSWORTH, of Boston, (*ibidem*,) relates the case of a young lady suffering from *headache*, the larger part of which was *referred to the eyes*. In a few moments after placing a drop or two of cocaine on the conjunctiva of each eye, the pain in the eyes was wholly relieved and the headache much lessened.

Dr. A. ALT, of St. Louis, (*Amer. Jour. of Ophthal.*, Nov. 15, issued Dec. 20,' 84,) reports his experience after having used cocaine for a month. In iridectomy, he has several times dropped cocaine on the iris, which he had caused to prolapse, and in a few minutes he found that the excision was almost painless. He thinks that it has a direct influence on the nerves of the blood-vessels. He noticed that it had a decidedly quieting effect on the oscillatory movement of an eye not perfectly blind, and mentions, with great emphasis, its benefit in a case of severe iritis after extraction, which terminated favorably by the benefit derived from cocaine, the solution instilled every few hours having removed pain and anxiety, and given the patient rest.

Dr. W. HUNICKE, of St. Louis, Mo., (*ibidem*, p. 229,) noticed that after instillation of cocaine, the cornea appeared dry, and the reflection from it somewhat diminished. He asks, why?

The paper of Dr. JOHN GREEN, of St. Louis, Mo., (*ibidem*, p. 231,) contains some very valuable observations. In a case of keratit. phlyct., in which the frequent instillation of a one-half-per-cent. solution of atropia during two days had produced only a half dilatation of the pupil, a single instillation of the cocaine solution gave complete relief from pain, and was followed within ten minutes by a dilatation of the pupil nearly *ad maximum*. G. ascribes this to the sedative action of the cocaine, permitting the atropia to have its full effect.

In *iritis* no remedy approaches cocaine in giving full and prompt relief from pain. It is especially efficient as an *adjuvant to atropia*, in dilating the pupil and rupturing adhesions.

In two cases of nystagmus he could confirm Alt's observation, that the movements were considerably quieted by cocaine; in a third they were not. (The present writer used it in four cases,—results negative.)

In "*extraction of cataract* the iridectomy can be rendered painless by producing an artificial prolapse of the iris, and applying a little of the solution to the prolapsed portion. But regarding the safety of the procedure, the occurrence of suppuration in the single case in which I have practised it compels me, for the present, to suspend judgment."

Dr. S. C. AYRES, of Cincinnati, O., (*ibidem*, p. 238,) used cocaine in a case of *bullous keratitis*. The removal of the epithelium, and applying an almost saturated solution of carbolic acid to the cornea on a line marking the boundary of the bleb, produced scarcely any pain. In a case of *granular conjunctivitis with great* photophobia, atropia did not seem to have much influence on the pupil. After getting the full influence of the cocaine, the pupil was widely dilated, and remained so.

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The foregoing pages contain every thing on cocaine that has appeared of interest in the American medical literature, as far as it has reached me up to date, Dec. 24, 1884. No doubt a number of valuable contributions have not come to my notice, but the above extracts will give a faithful picture of the enthusiasm, energy, and quickness with which the American mind seizes upon every thing that is of practical importance. I have arranged these extracts in chronological order for two reasons: first, to secure each author the right of literary priority to which he is entitled; secondly, to show the gradual growth of our knowledge on the physiological and therapeutical action of cocaine.

EUROPEAN CONTRIBUTIONS.

The abstracts from the European literature on the subject, to which I now proceed, will be much shorter, for only very little of it has thus far reached me. Future numbers of the ARCHIVES will keep our readers informed of every thing that is new and important.

The *Revue Générale d'Opthalmologie*, Oct. 31, '84, p. 433, contains an article of Dr. E. MEYER, from which the following extracts are of particular interest. "The instillation of cocaine causes a certain pallor of the conjunctiva, and at the

same time a diminution of its normal secretion, and the tension of the globe appears perceptibly (sensiblement) diminished to the touch. These phenomena, and the dilatation of the pupil, indicate a diminution of the quantity of blood in the ocular vessels, though I have not been able to recognize the same with the ophthalmoscope in the background of the eye."

Dr. AD. WEBER, of Darmstadt, writes to Dr. M. "that when the pupil is dilated by atropine, cocaine will enlarge it considerably more, and that by the combination of the two remedies he has seen adhesions of the pupillary border give way that had resisted for weeks the action of atropia alone."

"Cocaine renders the inflamed conjunctiva as insensible as the normal. It seems to exert no injurious influence on the regular recovery of eyes operated on. The diminution of the eyeball tension accounts for the flattening of the cornea after the incision, which has surprised me, and made the expulsion of cortical remnants a little more laborious, but I have not noticed that it prevents a regular coaptation of the wound at the end of the operation."

Dr. E. JELINEK, of Vienna, read a paper on "Cocaine as an Anæsthetic and Analgesic of the Pharynx and Larynx," before the Vienna Med. Soc., Oct. 24, '84, and published it in the *Wien. med. Wochenschr.*, Nov. 8 and 15, '84. He says that in Vienna, since Türk, concentrated solutions of morphine had been brushed on the pharynx and larynx, but that cocaine had been used—first by him, and almost simultaneously by Dr. Dworak—after Dr. Koller had informed them of his experiments with this remedy on the eye. He had to increase the strength of the hydrochlorate (Merck's) to 10 % and 20 % (the latter especially for operations in the larynx), which could be done only by adding alcohol to the water. For the ten-per-cent. sol. he took: Cocain. mur., 1.00; aq. dest., 8.00; alcohol, 2.00. For the twenty-per-cent. sol. the relation is: coc., 1.00; aq. dest., 3.00; alcoh., 2.00. When a concentrated solution or the powder is brought in contact with the mucous membrane, we notice that the sensations of touch, temperature, taste, and pain are diminished, as well as the tenderness on manipulation and the reflex

excitability. He lays stress on the necessity of painting the whole mucous membrane as far as it may come in contact with instruments, for reflexes will be produced if the smallest part has escaped the influence of the remedy. He enters fully into the details of pharyngeal and laryngeal applications and operations, the extensive copying of which would be out of place in THESE ARCHIVES. He praises, in particular, the benefit derived from cocaine in dysphagia accompanying perichondritis—mostly tuberculous—of the epiglottis and larynx. The application of the remedy in one of these cases, with dramatic effect, is related in full, and he adds that in all such cases that had come under his care, thus far, the result has been equally beneficial. His observations are in perfect harmony with those of Dr. Lefferts, mentioned above. For intra-laryngeal operations he uses a strong, hypersaturated watery solution, shaking it, of course, before the application. He further states that two other properties of cocaine will probably prove practically useful, *viz.*: its hæmostatic (anæmisirend) action in contracting swollen portions of the mucous membrane (verified since by Bosworth and others), and its diminishing action on secretion. He has found no injurious secondary effect from its application.

The **English** reports on cocaine have been very cool at first, but more appreciative later. Mr. A. BENSON said at the meeting of the Opthalmological Society of the United Kingdom, Oct. 9, '84: "So far as his experience went the drug was of no appreciable assistance in operations, the anasthæsia being too imperfect." Mr. M. GUNN had used cocaine in three cases, and had come to the same conclusion. Mr. NETTLESHIP had tried it in two cases; it had produced marked anæsthesia without any inconvenience, and he suggested that if the drops were frequently instilled, so as to maintain the effect, the drug might be practically useful.—*Ophthalmic Review*, Nov., 1884, p. 351.

The number of Dec. 6, '84, of the *Brit. Med. Jour.*, has seven articles on cocaine, all more or less appreciative, but containing nothing new. It is characteristic of conservative England that medical men were waked up to the re-

markable advantages of a new remedy fully six weeks later than their American brethren, whereas with an equal spirit of receptiveness and progressiveness they ought to have been two weeks before them.

M. VULPIAN communicated his experiments to the Acad. des Sciences, at its meeting on Nov. 18, '84 (*Arch. Gén. de Méd.*, Dec., '84, p. 756, and *Brit. Med. Jour.*, Dec. 6th, p. 1759). When cocaine is injected into the veins of the dog, it is followed by symptoms similar to those produced by electrifying the cervical branch of the sympathetic: protrusion of the eyeballs, dilatation of the pupils, insensibility of the cornea, slight diminution of sensibility in the extremities, and marked increase of the secretion of the submaxillary salivary glands.

Dr. KÖNIGSTEIN, of Vienna, (*Wien. Med. Press.*, 1884, Nos. 42 and 43; *Centralbl. f. Augenh.*, Nov., '84, p. 345,) at the request of Dr. Freud, experimented with cocaine simultaneously with, and independently of, Dr. Koller, obtained the same results, but had not yet arrived at final conclusions when Dr. Koller sent his communication to the Heidelberg Congress. The drug does not seem to act on the peripheral sensitive nerves alone, for many symptoms make it probable that the sympathetic is also influenced.

Prof. J. HIRSCHBERG, of Berlin, (*Centralbl.*, Nov., '84, p. 345,) has used cocaine in thirty-six operations. Among them are seventeen *extractions of senile cataract*, all of which passed normally and recovered "irreproachably." In one case of tattooing a corneal leucoma, the bundle of needles was introduced boldly and obliquely into the scar, and China ink, of syrup consistence, was thoroughly rubbed in with the finger.[1] Pain slight.

Dr. L. HOWE, of Buffalo, experimented with cocaine on animals, under the direction of Prof. Zuntz, in the Zoöphysiological Laboratory of the Agricultural High-School at Berlin. He published in *Fortsch. d. Med.*, ii., No. 22, his results as far as obtained Nov. 15th. The *Centrabl. f. pr. Augenh.* gives them in abstract, of which we will mention

[1] Hirschberg says that in this manner the largest leucoma can be blackened in one sitting. The globe must be depressed by toothless fixing-forceps otherwise the conjunctiva also will be colored.

the following: The action of a 4 % or 5 % solution seems to surpass but little that of a 2 % solution.

After instillations into the conjunctival sac, a considerable quantity of the alkaloid penetrates into the anterior chamber. The aqueous humor drawn with an hypodermic syringe out of the anterior chamber of an eye into which cocaine has been repeatedly instilled, can be used to anæsthetize another eye.

GENERAL REMARKS.

There is an extensive earlier literature on coca and its alkaloids, of which I shall give only brief extracts, supplementing them by statements taken from the newest literature, so as to give a kind of synopsis of our knowledge on this plant as far as it concerns the physician.

A.—Pharmacological Notes.

The leaves of Erythroxylon coca (Lamarck) have for centuries been used as a stimulant by the natives of Peru and Bolivia, and they have been warmly recommended and extensively tried for almost all kinds of diseases, but without satisfactory results. In the year 1855 Dr. F. GAEDCKE separated from them, in the laboratory of Dr. Sonnenschein, an alkaloid which he called erythroxiline. He had only two ounces of leaves to work on, but he describes his procedure accurately in the *Archiv der Pharmacie*, vol. cxxxi., pp. 141–150, Hannover, 1855: "The peculiar action of the coca leaves suggested to my mind the supposition that they contained theine, or a body akin to it." He made watery and alcoholic extracts from the leaves, but could not obtain crystals from them by any kind of procedure and reagents, until he subjected them to dry distillation, according to the process which Steynhouse recommends for the discovery of theine. He obtained in the neck of the retort small needle-shaped crystals, distinctly recognizable with the naked eye, made out clearly with a magnifier. The quantity was too small to free a sufficient portion entirely from accompanying products of dry distillation. He could, therefore, not ascertain whether they were identical with theine, nor study their properties. He promised to do this as soon as he could obtain a larger quantity of coca leaves.

In the issue of the *Medical Record* of Nov. 15, 1884, Dr. SAMUEL R. PERCY, of New York, claims priority of the discovery of cocaine, or, as he calls it, erythroxyline. Nov. 4, 1857, he read an exhaustive paper on the leaf of erythroxylon coca before the N. Y. Academy of Medicine. On Dec. 2, 1857, he exhibited to the Academy a scruple of the alkaloid, which he left with the librarian. He stated that the hydrochlorate of erythroxyline had a peculiar but not unpleasant benumbing and paralyzing effect upon the tongue. "The librarian of the Academy has been unable to find the paper or the alkaloid, but the fact of such a paper having been read, is recorded on the books of the Academy."

A thorough and most instructive paper on coca and its chemical analysis was published by Dr. A. NIEMANN, of Goslar, Germany, in the *Vierteljahresschr. für practische Pharmacie*, vol. ix., pp. 489–524, Munich, 1860. He received a sufficient quantity of good coca leaves for examination from Prof. Wöhler, of Göttingen. On Wöhler's request, Dr. Scherzer had bought the leaves in Lima and brought them to Vienna on the Austrian frigate "Novarra," which had made a voyage round the world chiefly for scientific purposes. Niemann investigated the coca leaf thoroughly, separated the alkaloid, which he called cocaine, made several salts of it, the hydrochlorate, sulphate, nitrate, and acetate, studied its chemical reactions, determined its atomic weight, but did not investigate its physiological action, mentioning only that a very diluted, probably too diluted a solution of the hydrochlorate did not dilate his pupil.

M. LOSSEN, 1862, examined cocaine again, and published his results in his Inaugural Dissertation, and in the *Ann. Chem. Pharm.*, 121, 374, and 133, 352. He gave it the formula $C_{17}H_{21}NO_4$; that of Niemann was $C_{16}H_{20}NO_4$. Lossen discovered in the coca leaves another volatile alkaloid, hygrine, which is not yet sufficiently investigated.

A very good compilation of the most important literature and the chemical and physiological action of erythroxylon and its alkaloid is found in "*Die Pflanzenstoffe*," by Husemann and Hilger, p. 881, etc., Berlin, 1882. More or less extensive abstracts from this work are found in some of our medical journals.

An excellent description of coca, with illustrations, is contained in the *Pharmazeutische Rundschau*, New York, Dec., 1884, p. 260, etc., by Dr. Fr. Hoffmann, and an interesting paper is that of Dr. E. R. Squibb, "Cocaine," in his *Ephemeris* of Nov., 1884, p. 685, etc.

The chief manufacturer of cocaine is Merck, in Darmstadt, from whom almost all that has been used thus far was furnished. I have tried a sample given me by Messrs. McKesson & Robbins, of New York, as their own make, which acted as well as Merck's. Parke, Davis, & Co., of Detroit, and others, manufacture it likewise, and their products have been found good.

B.—Physiological Action.

The foregoing pages contain so much of the physiological action of cocaine that a repetition would be tiresome. Suffice it to say that cocaine acts as an anæsthetic and analgesic on all mucous membranes with which it is brought in contact, the same on the skin and deeper tissues into which it has been injected or to which it has been applied through incisions and wounds. It paralyzes the sensory nerves and the posterior columns of the spinal cord, but not the anterior (Ott, "Cocaine, Veratrum, and Gelsemium," Philadelphia, 1874). The semicircular canals appear particularly affected —disturbances of equilibrium, absence of co-ordination, rotating spasms (v. Anrep, *Arch. ges. Physiol.*, 21, 38, 1880). The pupil is dilated, not ad maximum, and remains responsive to light, though less than normal. The power of accommodation is diminished, not totally suspended. Mucous membranes are bleached and thinned, their secretion is lessened, the tension of the eyeball is diminished. It acts locally on the peripheric sensitive and sympathetic nerve-fibres, and when injected into or near the trunks of sensitive nerves it paralyzes the whole distal part of those nerves (Hall & Halsted, *N. Y. Med. Jour.*, Dec. 6, 1884, p. 643). It causes a diminution of tactile, painful, and thermal impressions, and abolishes reflex irritability. Its action is transient, but can be maintained for hours by repeated application. It has no cumulative effect, and exerts no bad influence on the nutrition of the parts subjected to its action, as far as we can

judge from the observations up to date. Constitutional symptoms after the injection of from five to thirty-five minims and more of a four-per-cent. solution once or several times and even from instillations of a few drops into the conjunctiva (T. R. Pooley) have been noticed. They consisted in headache, dizziness, nausea, unsteadiness of gate, deadly pallor of skin, and cold perspiration. These symptoms were transient, and never had injurious after-effects.

It is easily understood that a substance with such a physiological action will have a wide field of beneficial

C.—Therapeutical Application.

This is owing to its action :

(1) As an *anæsthetic* and *analgesic* in a great number of painful diseases, irritative conditions, and inflammations of different kinds in many organs, unpleasant methods of examination, and painful operative procedures. The abolition of reflex excitability, a consequence of the anæsthetic action of the drug, is of the greatest service in many affections, such as photophobia, blepharospasm, headache (reflex), dysphagia, asthma nervosum, and many other kinds of reflex spasms.

(2) As a *vaso-constrictor* (hæmostatic) agent. It will bleach the tissues, diminish hemorrhage, contract vascular (erectile) tissue in the nose, penis, ear, etc.; thus by enlarging cavities and canals facilitate the introduction of instruments and the inspection, cauterization, and operation of deep-seated parts. It will dilate the pupil, and by its analgesic effect favor and increase the action of other mydriatics.

The *transient nature* of its action makes it particularly valuable when we desire its service only for a short time—for instance, in ophthalmoscopic, rhinoscopic, laryngoscopic, and other examinations; whereas, on the other hand, its action can be maintained at will by repeated applications during operations of longer duration. Its *diminishing effect on secretions* is mentioned by several observers, and will, if confirmed, be of great benefit.

It is of decided advantage as an *adjuvant* to many remedial agents, operative procedures, and the vis medicatrix naturæ; for instance, as an analgesic it will prevent in-

flamed parts from dispelling sleep; it will afford rest—the chief requirement of obtaining primary union of wounds,—and in quieting the nerves of one part, quiet the nervous centres and the mind.

Thus far it has found a useful field of application in :

(1) Ophthalmology.
(2) Otology.
(3) Rhinology, pharyngology, and laryngology.
(4) Genito-urinary surgery.
(5) Gynæcology.
(6) General surgery.

Before concluding this communication I beg to review its

Particular Use in Ophthalmology,

as shown in the preceding abstracts and verified by my own experience.

A.—Operations.

Cocaine is of the greatest benefit in *cataract-operations.* Divisions of the capsule, primary and secondary, being absolutely painless throughout, can be executed with the necessary precision, without the liability of an accident by an unforeseen movement of the patient. Prolapse of vitreous, entrance of capsule or iris into the stitch canal when the needle is withdrawn, are less likely to occur, on account of the diminution of eyeball tension produced by the drug, and the absence of reflex contraction of the ocular muscles.

The same holds good in extraction. The precision with which every step of the operation ought to be performed is greatly assisted by the absence of pain and the diminution of bleeding. The section, being painless throughout, can be accurately executed as to location, size, and direction. The final cleansing and adaptation of the wound are exceedingly facilitated by cocaine. The patient, having his full consciousness, will turn his eye in every direction desired, while the insensibility of the parts will permit the removal of clots and portions of lens, the reduction of the iris from the corners of the section, and the smoothing of the conjunctival flap without any spasmodic flying off of the ball. The capsulotomy will also be rendered easier and surer by the anæs-

thesia, but it is somewhat more difficult to introduce the cystotome, as the wound does not gape so readily. Frequently the point of the knife wounds the skin near the inner commissure in the progress of the corneal incision. This is felt as the first pain by the patient, and sometimes causes an involuntary movement. This movement may occur also during the iridectomy, which is painful. Knowing the fact, we can prepare the patient and ourselves for its consequences, which need not be of any account, as the pain is but slight. I have not yet dropped cocaine into the wound, nor injected it into the anterior chamber, for I dislike to protract the operation in any way. Apart from all considerations of mischievous bacteria, always and everywhere ready to pounce upon a wound, we can easily believe that the less a wound is exposed to the air, and the less it is manipulated, the greater are its chances for primary union. This shows us another advantage of cocaine; it allows us *to operate quickly, yet with precision.* Its advantage over ether is immense. Ether anæsthesia, if complete, quiet, and uninterrupted during the operation, must in many cases be allowed to pass, before remnants of lens can be removed, and the wound cleansed and adjusted. In many persons the struggling, congestion, vomiting, and unmanageableness when they awake from the etherization, are very unpleasant hindrances to a smooth operation. In cocainization a marked diminution of eyeball tension is often noticed, the cornea wrinkles, and in some cases after the expulsion of the lens, sinks in as if half the eye had been emptied. The expulsion of the lens and of remnants requires more outward pressure, but *wards off accidents*, for the eye is insensible. A consequence of this diminution of pressure, which I have noticed in the majority of cases, is the fact that the iris rarely prolapses spontaneously. This I consider to be an advantage, for we obtain a more regular, key-hole-shaped pupil when we grasp the iris within the anterior chamber than when it lies irregularly folded in the wound.

I have not noticed any injurious effect of cocaine on the healing of the wound. I have made twenty-four extractions under cocaine; twenty-three recovered without disturbance,

one suppurated. This was a case of chronic conjunctival catarrh, with considerable discharge from both eyes the next days after the operation ; the patient was a very restless woman, and the operation had not been quite free from complications. I had repeated the capsulotomy, and during an unexpected movement of the patient the cystotome had slightly grazed the iris.

In iridectomy for *glaucoma* cocaine is of advantage, but requires particular *caution* at the moment of seizing the iris ; this being the first and only pain the patient experiences, his eye is apt to make a sudden spasmodic upward movement, which may bring the branches of the forceps in contact with the anterior capsule and rupture it. The patient, as well as the assistant that steadies the eye, ought to be prepared for this emergency. The assistant who steadies the eye with the fixing forceps is liable to hold it very loosely only, because the anæsthetized eye does not move, when on a sudden it feels the pain and flies up. I have made only five glaucoma iridectomies under cocaine, but this movement occurred in two of them, and also in several extractions. Another disadvantage of cocaine was noticed in a case of chronic glaucoma, in which it dilated the pupil *ad maximum*, so much so that the whole iris was concealed under the arcus senilis of the cornea. I had to make the incision without the protection of the capsule by the iris and without seeing either. After the incision the pupil remained dilated, and I had to make the iris prolapse by pressing on the posterior lip of the wound. In another case I made a good-sized corneal incision with a lance-knife, and when I withdrew the instrument the anterior chamber did not empty, the aqueous escaped only when I introduced the forceps. This shows more than any thing else the perfect rest of the eye and its absence of reflex movements on the part of recti and orbicular muscles.

The proper corrective of cocaine mydriasis is a drop of eserine, instilled soon after the cocaine, which will produce a full contraction of the pupil (without diminishing the anæsthetic effect of cocaine), even if cocaine is repeatedly dropped in after the eserine. The sensitiveness in iridecto-

my may be eliminated, as has been seen before, by dropping cocaine on the prolapse, or injecting it into the anterior chamber, which can readily be done with E. Meyer's lachrymal syringe. I do not like injecting any fluid into the eye, not even a perfectly fresh, pure solution of cocaine, or one to which an antiseptic has been added. Before I recommend this procedure, I want to have the support of further experience from those that have tried it.

Of a number of diverse *operations on the cornea*, paracentesis, splitting according to Saemisch, abscission of partial or total staphyloma, incising and scraping out pustules or torpid infiltrations, tattooing, removal of deposit of lead or chalky film, removal of foreign bodies, etc., I need not speak in particular. They can all be done under cocaine anæsthesia in the most satisfactory way.

Operations on the *conjunctiva*, extirpation of small tumors, pterygium, symblepharon, and the like are much facilitated by cocaine anæsthesia. It is recommendable in these operations to use a stronger solution, 8 %,—those over 5 % require, of course, a corresponding addition of alcohol,—and instil it on the wound during the progress of the operation.

The same rule ought to be followed in operations on the *muscles and the lids*, *e. g.*, simple tenotomy, advancement, canthoplasty, tarsoraphy, uniting lacerated or incised wounds, scraping or cutting out chalazia and denser tumors, entropium, ptosis, etc. Subcutaneous injections, for appropriate cases, answer very well.

Enucleation of the globe can be done either by successive instillations during the operation, according to C. S. Turnbull, or by injecting a few drops into Tenon's capsule along the recti muscles, as D. C. Cocks has done. Both procedures will prolong the operation unduly. Injecting a few drops directly into the orbit close behind the globe has answered me well in two cases (see above), and is as follows: when the conjunctiva is anæsthetized by instillation, the eyeball is forcibly drawn toward the nose. This will bring the posterior segment near the outer commissure, from where the hypodermic needle can be introduced, and a few drops—one or two will probably be sufficient—are injected where the ciliary nerves enter the

globe. All this is painless and in two or three minutes the operation can be begun. The division of the recti muscles will be connected with some pain, but the remainder of the operation will not, and there will be very little hemorrhage from the orbit on account of the hæmostatic action of cocaine. From so small an amount of the solution injected no general symptoms of any importance, should they occur at all, need be feared. If a drop or two anæsthetizes the cornea and conjunctival sac, then an equal dose will be likely to produce the same effect on the ciliary nerves if injected into the loose cellular tissue of the orbit.

In removal of circumscribed *orbital tumors* injection of a few drops behind them will probably anæsthetize the locality so as to operate painlessly.

In *lachrymal difficulties*, cocaine may be instilled so as to reach the canaliculi, but the deeper parts, sac and nasal duct, can only be anæsthetized by injections with the syringe. Meyer's small syringe will answer best, admitting of the injection being made without slitting the punctum.

In the removal of *foreign bodies from the interior of the eye*, cocainization by repeated instillations into the conjunctival sac is of the greatest advantage. The rest, the absence of reflex motions, and the diminution of eyeball tension produced by the drug, will render prolapse of iris and vitreous less frequent and less extensive, and assist the operator in the correct handling of his instruments. Only a few days ago I saw the benefit of cocaine exemplified in a successful extraction of a splinter of iron with an electro-magnet by Dr. GEO. J. STEVENS, in which operation I had the privilege of assisting.

From the above statements it follows that *almost all operations* on the eye can be performed under cocaine anæsthesia. The rules which I have given in the general remarks are supported by actual experience of other oculists or my own, as will be seen by the abstracts from the current literature in the first part of this paper. Whether that which can be done is under all conditions the best to do, is another question. In children and frightened people, for obvious reasons, there always will be an indication for general anæsthesia. In rare cases the anæsthesia

from cocaine instillations is so superficial that corneal incisions are intensely painful, and ether has to be resorted to. Dr. JAS. A. SPALDING, of Portland, Maine, writes me, that repeated instillations of a three-per-cent. solution, which completely anæsthesized the conjunctiva and cornea for speculum and forceps, in a case of absolute glaucoma, did not prevent the patient from experiencing such intolerable pain at the corneal incision as to make it necessary to complete the operation under ether.

B.—The *mode of applying cocaine* will be by instillations, painting the tissue before and during the operation as the case may be, and by injections into the diseased part or its surroundings. In particular cases injecting the solution in or near a nerve-trunk when we want to operate in the region of its peripheric distribution, may prove of advantage. As to the doses we ought to be cautious, for though 1.00 grm. taken internally, in an attempt at suicide, is reported not to have been fatal, unpleasant symptoms have occurred after injections of from six to thirty-six minims of a four-per-cent. solution. Some persons seem to have an idiosyncrasy against the remedy. Aside from my own experience I have heard some of my friends say that injections of five or six minims into the lids produced unpleasant general symptoms. Dr. T. R. POOLEY noticed that two drops of a four-per-cent. solution instilled into the conjunctiva produced in ten minutes such extreme dizziness that the patient, a robust girl, feared to rise from the chair lest she should fall. She did not lose color, nor was their any nausea, but her pupil was widely dilated. She recovered quickly. None of these cases showed alarming symptoms, but we are only at the beginning of our acquaintance with the remedy, and it seems prudent to advance cautiously.

C.—As regards the *therapeutic action* of cocaine, I have nothing to add to what I have said above (p. 41). My experience and the publications on that point are too limited as yet to deduct from them any general rules. In a number of cases of acute iritis, I have been able to confirm the benefit of a combined instillation of cocaine and atropine which Koller, A. Weber, J. Green, and others have recommended. The pain was allayed and the course of the inflammation abridged.

The following note, kindly sent me by Dr. F. P. Kinnicutt, of New York, is of interest:

During the past six weeks I have used cocaine in a number of cases of *facial neuralgia* with very satisfactory results. My experience coincides with Dr. Murrel's of London, in regard to the necessary strength of solutions for external application in this affection; a ten- to twenty-per-cent. solution is required. I have employed oleic acid as a solvent rather than the oil of cloves recommended by Dr. Murrell. I rub in with the finger eight to ten minims of the oleate along the course of the painful nerve, with the effect of affording very speedy and marked relief. My experience is confined to cases of neuralgia of the ophthalmic division of the trifacial nerve.

I have been able to compare the effect of cocaine used after the above method and given hypodermatically. The relief following hypodermic injections is almost instantaneous, and thus far in my experience constant. In supra-orbital neuralgia, the injection has been made in the loose supra-orbital tissue, near the point of exit of the nerve. The only objection to this method is the slight pain caused by the injection. In my own judgment it is to be preferred to the external application of the salt. Three to four minims of a four-per-cent. solution has been found to be sufficient.

USE OF COCAINE IN OTOLOGY.

By H. KNAPP.

MY personal experience with hydrochlorate of cocaine in aural surgery is limited, but encouraging. If I supplement it by what has been published after so short a time of trial, I may fairly ascribe to the remedy a considerable extent of useful application in this field.

Catheterization of the Eustachian tube through the nose is greatly facilitated by previously applying cocaine to the lower nasal passages and to the pharyngeal orifice of the tube. This can be done with an atomizer, or a brush, or a cotton pad at the end of a probe. The mucous membrane becomes insensible and thin; the catheter glides over the parts without pain, and is introduced more readily because of the dilatation of the nasal passages. This remedy will render direct catheterization possible in certain cases, in which otherwise it could only be effected through the mouth or the nostril of the other side. Whether these methods are so efficient as the introduction of the catheter through the nostril of the same side, I know not, but I do know that changing the classical bend of the catheter by making it straighter in order to pass it through a narrow or crooked nasal passage, renders catheterizations, both for purposes of inflation and injection, proportionately inefficient. It would be too troublesome had we to apply cocaine often in the same case; fortunately this is not necessary, for when the remedy has helped the patient over the discomfort of the first trials, the repeated introduction and treatment have made the manipulation easy.

Injections of cocaine into the Eustachian tube will, by their contracting influence on the blood-vessels, dilate the calibre of the canal, facilitate inflation and injection of liquids into the tube and the tympanic cavity.

It may be of advantage—though I am not aware that it has ever been tried—to inject one or several drops of cocaine, warm, through the E. tube into the drum cavity for severe earache of inflammatory origin. It might also be injected through the drumhead with a hypodermic syringe.

Instillations of cocaine into the external ear-canal in cases of *neuralgic earache* have been found useful by Roosa and Da Costa.

On the benefit derived from *inflammatory earache*, Dr. F. P. KINNICUTT writes me as follows:

> I have very lately used a four-per-cent. watery solution in three cases of acute "earache" in children.
>
> By means of a speculum and "dropper," I have applied one or two minims directly to the drum membrane, in each case with immediate and complete relief; there was no recurrence of the pain.

In *tinnitus aurium* I have not found any improvement from instillations of cocaine, though I have made them repeatedly.

In all conditions that require manipulation, or the application of remedies, or incision, scraping, torsion, avulsion, écrasement, etc., in *the tympanic cavity*, when the drumhead is perforated, or in *ulcers of the ear-canal and the auricle*, local anæsthesia can be easily and satisfactorily effected by instillation of hydrochlorate of cocaine. The tissue-contracting and hæmostatic effect of the drug will greatly add to its value in all operations on the middle ear. These operations are particularly difficult on account of the narrowness of the ear-canal and its obstruction by the slightest hemorrhage. In prolonged operations—for instance, the removal of multiple polypi—the instillations should be continued during the operation. I have derived great advantage from this procedure in several operations.

Also in cases of *acute purulent otitis*, accompanied by intense pain, where the tenderness of the swollen walls of

the meatus made cleansing both by syringing and the dry method excessively distressing to the patient, have I noticed great benefit from cocaine instillations. The manipulations were made easy, the cleansing could be thoroughly done, and the application of remedies—boric acid and weak solutions of corrosive sublimate—caused no annoyance. This treatment, because of its painlessness, was regularly carried out, and the recovery was smooth and speedy.

The *application of painful remedies* in cases of *chronic purulent otitis*—for instance, nitrate of silver, alcohol, etc.—can be done, after cocainization, with great or entire relief from pain.

The analgesic effect of cocaine has been noticed by J. Bettman, other aurists, and myself, in cases of *earache* when the *perforation* of the drumhead gives the remedy access to the middle ear.

Dr. C. S. Bull reports that he has performed *perforation of the membrana tympani* in three cases with entire absence of pain. In my experience instillation of cocaine upon the healthy or inflamed non-perforated drumhead did not diminish its sensitiveness to the touch of a probe, and an incision in these cases could not have been painless.

Operations on the *walls of the ear-canal, the auricle, and its surroundings*, such as removal of tumors, incisions into the skin, etc., can be rendered painless by subcutaneous injections of cocaine, if the transient freezing with ether or rhigolene spray is not preferred. A few days ago I enucleated a cystic tumor, the size of a cherry, from the posterior surface of the lobule. The lobule and the tumor were held between the branches of an eye-lid clamp. Two drops of a three-per-cent. solution of cocaine were injected under the posterior side of the tumor, and two under the anterior. The tumor was shelled out entirely without pain and without loss of blood.

COCAINE IN THE UPPER AIR-PASSAGES.

By F. H. BOSWORTH, M.D.,

PROF. OF LARYNGOLOGY, BELLEVUE HOSPITAL MEDICAL COLLEGE.

COCAINE possesses two separate and distinct properties in its action upon the mucous membrane of the upper air-tract. It not only acts as a local anæsthetic, but also possesses properties of so singular and striking a character as to render it one of the most valuable, if not the most valuable, single drug in our pharmacopœia as a local therapeutic agent. The discussion of the subject would then properly fall under two heads: 1st, cocaine as a local anæsthetic; 2d, cocaine as a local therapeutic agent.

COCAINE AS A LOCAL ANÆSTHETIC.

In the Nasal Passages. All observers coincide in the statement that a solution of cocaine when properly applied to the nasal mucous membrane renders it absolutely insensible. The method of application is very simple. A small pledget of cotton is saturated with the solution and placed upon the membrane, and allowed to remain for about eight minutes. At the end of this time simple superficial cutting operations may be accomplished, or the part cauterized with the potential cautery or by means of any of the chemical agents without sensation. The only care to be exercised is that the part to be cut or cauterized shall be thoroughly covered with the cocainized pledget. In using the snare for the removal of large masses of hypertrophied tissue, the cocaine very markedly mitigates the pain, but that it completely eliminates it has not been my

own experience, or that of any other observer as far as I know.

In operating upon a deflected septum, I have usually allowed the cocainized pledget to remain over the part for at least ten minutes, or even longer. In these cases the operation was completed with very much diminished pain, and in two, the patients assured me that the pain was entirely eliminated. The operations consisted in cutting off the projecting angle of deflection.

In operating upon nasal polypi, the difficulty which presents is in applying the cocaine to the parts which it is designed to render anæsthetic. In my own experience the cocaine has not rendered the operation entirely painless. The polypi so far occlude the cavity as to render access to the membrane in many cases impossible. What the cocaine does do in these cases is to render the mucous membrane, which must be traversed by the instruments used in operating, so far insensible as to remove one of the most painful features of the operation. As each lower growth is extirpated a fresh application may be made, and the operation made a comparatively painless affair. The strength which is to be preferred for use in the nasal cavity is the four-per-cent. solution, though I have frequently accomplished all that could be desired with a two-per-cent. solution. The latter strength, as a rule, requires a longer time to accomplish the purpose. By far the best method of making the application is by means of a pledget of cotton or a piece of sheet lint. By this method the application can be confined to the part on which it is designed to operate, for as a rule there is no especial reason for anæsthetizing the whole nasal cavity. If it is desired to anæsthetize a portion of the membrane where it is not feasible to place a cocainized pledget, the part can be rendered fairly anæsthetic by passing over it, at intervals of two or three minutes, a pledget of cotton wrapped on a probe and saturated with the cocaine solution. This is certainly far more efficient than making the application by the atomizer or syringe, or dropping it into the cavity.

In the Vault of the Pharynx. The principal occasion for rendering the vault of the pharynx insensible is for

the purpose of removing hypertrophied pharyngeal tonsils, the so-called adenoid growths. In my first experiments in this region, I passed a cocainized pledget on bent probe into the pharyngeal vault, passing the instrument behind the palate. The palate was immediately retracted in each case, the probe seized, and the cocaine diffused over the upper surface of the soft palate, and in part only upon the pharyngeal vault. In no case did I succeed in rendering the vault insensible. I then commenced to use a fine upward spray. In order to throw a spray into the vault of the pharynx, it is necessary that the soft palate shall be relaxed. Many patients will retract the soft palate unconsciously when the attempt is made. A little training, however, soon enables the operator to accomplish the manipulation at the first sitting. By using a cleansing solution for the practice, the patient very soon gets accustomed to the manipulation, and the cocaine solution may then be used. The spray producer, being attached to a compressed-air cylinder, is placed in position, and the pressure let on for an instant, the result is that a momentary jet of spray is thrown upon the part. This is repeated three or four times at intervals of two minutes. At the end of this time the parts are perfectly anæsthetized, and the growth can be removed painlessly. In several cases of adenoids, I should state, I have failed in making the application, on account of irritable fauces, but in no case in which I have succeeded in spraying the part with cocaine have I failed in rendering the operation painless. In these cases I used a two-per-cent. solution, the soft spongy tissue of the pharyngeal tonsil seeming to absorb the drug more thoroughly and deeply than the mucous membrane proper of the upper air-tract.

In the Fauces. By this region I mean the lower pharynx, soft palate, pillars of the fauces, faucial tonsils, etc. In cases of irritable fauces, which resist attempts at making a laryngoscopic examination, we have a most valuable remedy in cocaine for rendering the parts tolerant of the laryngeal mirror. In the few cases in which I have found myself balked in using a laryngeal mirror, I have succeeded in accomplishing all that was desired by spraying upon the parts a four-per-cent. solu-

tion of cocaine two or three times at intervals of three minutes. In this, as in all applications of cocaine by means of an atomizer, it is important that the tubes shall have very small openings, and that only sufficient of the solution shall be thrown upon the parts to cover them without flowing. When the compressed-air apparatus is not available I think the little single-bulb hand-ball atomizer, sold in the drug stores as Delano's atomizer, answers a most excellent purpose. The tube openings are very small, and the spray a very fine one.

In cutting the uvula, in a number of cases, I have completely anæsthetized the part by touching it with a four-per-cent. solution of cocaine. In none of these cases, however, was the cut made into the fleshy portion of the organ, elongation of the uvula very rarely indeed being due to any thing more than a sagging down of the mucous membrane. In removing the faucial tonsils I have made a number of attempts to render the operation painless by the application of cocaine, but in no single case have I succeeded. My attempts consisted in brushing or spraying the organs with a two-per-cent. solution and a four-per-cent. solution, repeating a number of times, and waiting from eight to twelve minutes, but in no case could I perceive that the drug had any marked effect either in lessening pain or controlling hemorrhage. In a recent case, I made every effort to gain some assistance from the application of cocaine in a nervous young lady who came to me for the removal of very large tonsils, but not only was the pain very severe, but I met with the first case of troublesome hemorrhage I have had in over a year. On the other hand, my friend, Dr. Camp, of Springfield, Mo., tells me that in his experience the cocaine has very marked effect in controlling the pain of the operation. His method of application is by means of a brush, pencilling the organ repeatedly for ten minutes with a four-per-cent. solution.

The faucial tonsil, as a rule, is a very hard, dense organ, containing largely of well-organized connective-tissue, and presents a consistency which is not well adapted for the absorption of cocaine applied to the surface, and there-

fore it is easy to understand that there would naturally be some difficulty in rendering it insensible. It has occurred to me that a better plan of procedure might be in injecting the cocaine into the base of the organ by means of a hypodermic syringe. I regret that I cannot report on the result of such a device at the present writing.

In one or two cases of chronic follicular pharyngitis I have used cocaine for its anæsthetic effect, before destroying the follicles with the actual cautery, but I am somewhat uncertain as to the result. The use of the cautery in the affection is attended with so little pain that it is a question whether the cocaine was of any practical value.

Dr. Lefferts, in a personal communication to me on the use of cocaine, writes: "Such a disagreeable result may follow its application to the pharynx for anæsthetic purposes that I have practically given up its use here." This result is "a paresis of the constrictor muscles of the pharynx and total inability to swallow, with a feeling as if the whole throat was filled with cotton. So alarming is this condition, lasting a half hour or more, that nervous patients will not endure it."

I have observed this sensation in experimenting on myself, and have also had patients complain of the same disagreeable feeling. I am disposed, however, to question whether it be a paresis of the constrictor muscles. The fauces being completely anæsthetized, the effort at deglutition necessarily will be extremely awkward. It is an attempt at swallowing virtually an empty space. One cannot go through the movements of deglutition unless there be something to swallow, even if it be but a small portion of saliva, the latter part of the act being completed by involuntary muscles whose contractions are excited by the presence of the bolus of food. Hence the attempt at deglutition with the fauces anæsthetized, one can easily perceive, might cause no little apprehension on the part of a nervous patient, the experience being a somewhat novel one. The point, however, which Dr. Lefferts raises is an interesting one, and there is room for further investigation. In all my observations on the local action of cocaine,

I have watched very carefully for any possible influence upon striped muscular fibres, and I am very confident that it has none. Its very remarkable effect upon unstriped muscular fibres I will discuss in the second portion of my paper.

In the Larynx.—In no portion of the upper air-tract would a perfect local anæsthetic be of such inestimable value as in the larynx. In the nasal passages and the pharynx we are rarely, if ever, balked of success in our operations or manipulations for the lack of such an aid; in the larynx, however, we are not infrequently compelled to subject our patients to a long and tedious course of training before we can successfully introduce the proper instrument for the removal of neoplasms. There still seems to be some question whether we possess in cocaine so reliable and thorough an anæsthetic that we can in all cases succeed in introducing a pair of forceps into the larynx at the first sitting without producing spasmodic closure of its cavity.

Dr. J. Solis-Cohen,[1] in writing on the subject, states that, while he succeeded easily in producing anæsthesia of the pharynx, his experience in attempting to secure laryngeal anæsthesia was very disappointing. He writes as follows: "On three separate occasions I applied as much as ten minims of a four-per-cent. solution at a time, keeping the brush within the larynx for at least five seconds, and repeating the application twice at intervals of five minutes. Although the patient stated that she was barely conscious of the presence of the probe I subsequently placed upon one of her vocal bands, the spasmodic, sphincter-like contractions of the laryngeal muscles shut the interior of the larynx out of view as completely as if no anæsthetic had been used." This patient was a lady. Dr. Cohen also records a similar failure in the case of a man.

In a personal communication, dated Jan. 12, 1885, Dr. Cohen writes as follows:

"To facilitate laryngoscopy in irritable or sensitive throats, to relieve pain in ulcerations,—as, for example,

[1] *Medical News*, Phila., Nov. 15, 1884.

odynphagia in tuberculous laryngitis—I find cocaine an extremely valuable agent. It has failed, in my hands, to overcome spasm of the larynx sufficiently to enable me to follow the instrument in the mirror, though obtunding the sensation of contact. I have not, however, used a solution stronger than ten per cent., though I see that they are using a twenty-per-cent. solution abroad. Since cocaine has been introduced, I have had but two cases of tumors in the larynx. In one I used it without any advantage over the ordinary manipulation with the forceps in the unanæsthetized larynx, which, by the by, is satisfactory enough. In the other case I did not try it." Dr. Cohen writes me further, on Jan. 15th: "Some weeks ago, I applied, on two patients in succession, a five-per-cent. solution to the larynx, and they both complained of a feeling as of a foreign body obstructing respiration, though I could see nothing to account for it. It was a nervous stricture, so to speak, but neither patient was neurotic—one being a lawyer, a member of select councils; the other, a very intelligent lady. I see to-day, in a reprint sent by Jurasz, of Heidelberg, that he has observed the same phenomenon."

Dr. Lefferts writes to me as follows: "I have used five-per-cent. and eight-per-cent. solution of cocaine with brush to the larynx in the attempt to relieve a distressing reflex laryngeal cough, there being no lesion of the larynx, except hyperæmia or slight acute laryngitis, but have failed in all cases. I have had no experience in producing anæsthesia prior to the removal of intra-laryngeal growths, but note that others have failed to do so in some cases, and that, though anæsthesia of the mucous membrane may be caused, reflex laryngeal spasm is not prevented." Dr. Lefferts adds, in a foot-note: "I may say that my drug and solutions are reliable. I believe that many experiments published have failed on account of an unreliable article having been used." The point certainly deserves attention.

Dr. Lefferts'[1] very important observation in regard to the use of cocaine in laryngeal phthisis has already been quoted by Dr. Knapp. My own observations fully confirm

[1] *Medical News*, Phila., Nov. 29, 1884.

all that Dr. L. has stated. I have used it not only in laryngeal tuberculosis, but also in a case of tuberculosis of the pharynx, with signal relief to the terrible distress in deglutition. Whether it possesses any power in retarding the progress of tubercular ulcerations is very questionable, but if we possess in it, as I think we do, an absolutely reliable palliative, its value in these cases cannot be overestimated. The relief usually lasts from twenty minutes to a half hour, during which time the sufferer may eat a fairly hearty meal without distress.

Dr. F. P. Kinnicutt, of New York, still further confirms this view, in a personal communication, as follows:

"The good results which I have obtained from cocaine, in cases of extensive tubercular ulceration of the larynx, have far exceeded those which I have ever produced by any other method of treatment. The applications have been made directly to the ulcerated surface, and instantaneous relief from suffering, extending over a period of several hours, has followed."

Dr. Elsberg writes me on January 9, 1885, as follows: "The application of a four-per-cent. solution cocaine chloride in the larynx dulls in most persons the dolorous sensibility; but the annulling of the tactile sensibility—by which temperature and pressure are appreciated—requires a stronger solution; and that of the reflex sensibility—from which result muscular contractions, as spasms, etc., as well as intra-vascular and secretory phenomena—requires a still stronger solution. For the latter purpose I have gradually increased the strength until I now use a twenty-five-per-cent. solution—*i. e.*, ʒ ii–ʒ i. The quality of the preparation may make some difference. I have had some of Merck's, but most of what I have used, and use now, I have obtained from Mariani & Co. Although on Oct. 30th I removed, with a four-per-cent. or six-per-cent. solution, I have forgotten which, a papilloma from the anterior commissure, in a throat exceedingly irritable previous to the application, and the patient averred that he positively did not feel the forceps at all, I am treating a case of tumor now in which nothing short of the twenty-five-per-cent. solution produces anæsthesia."

Dr. F. I. Knight, of Boston, writes to me under the date of January 11, 1885, as follows: "In brief, my experience has been that operating in the larynx is facilitated very much by the application of a strong solution of the cocaine muriate, especially a twenty-per-cent. solution. The anæsthetic effect comes on almost immediately and continues for a few minutes. The least effect has been produced on 'slobberers' in whom the excessive flow of mucus seemed to wash the anæsthetic off. In some cases the reflex has been wellnigh abolished, and operating made correspondingly simple."

My own experience in the production of laryngeal anæsthesia adds nothing to the above. I have made a number of applications to the larynx for this purpose, only one of which was in the case of a neoplasm. In this case, while sensibility to the probe was very markedly diminished, I failed entirely in controlling the spasmodic closure of the laryngeal cavity. The same results followed in a number of attempts to anæsthetize the larynx in health and in various states of catarrhal inflammation. I used no solution stronger than four per cent. In most of the cases I used a two-per-cent. solution, and I could not see that the stronger solution differed from the weaker, either in the rapidity or the thoroughness of its action.

In concluding this portion of the subject I think it may be safely asserted that we possess in the cocaine a drug by means of which the mucous membrane of any portion of the upper air-tract may be rendered insensible to pain, or to use Dr. Elsberg's admirable classification, that "dolorous sensibility" may be completely annulled. Furthermore, this result can be best obtained by means of a four-per-cent. solution, and in many, if not all cases by means of a two-per-cent. solution. "Tactile sensibility" may also be annulled, or so far reduced by the four-per-cent. solution as to very markedly facilitate most of the minor cutting operations, such as operations on the nasal septum, removal of polypi, amputation of the uvula, etc. If Dr. Elsberg's most interesting observations be confirmed by further experience, and "reflex sensibility" can in all cases be annulled

by his suggestion of a twenty-five-per-cent. solution, it would seem that the new anæsthetic is a perfect remedy.

COCAINE AS A LOCAL THERAPEUTIC AGENT.

In a communication to the *N. Y. Medical Record* for Nov 15, '84 I called attention to a new therapeutic use for cocaine. This observation I believe to be one of so great importance that much of what was stated in that article I repeat here with the additional light of a larger and longer experience which fully confirms all that was then claimed and more.

At that time I wrote: "In using a solution of cocaine in the nasal cavity for its anæsthetic effect I have observed an action which has not, as far as I know, been recorded. When the solution is applied to the mucous membrane, it is followed in about twenty or thirty seconds by a very notable contraction in the venous sinuses underlying the part which it reaches, and as the application is continued over the whole membrane covering the lower and middle turbinated bones, these sinuses become so rigidly contracted that all the blood which they may have contained is absolutely expelled, and the membrane clings closely to the bony structures which then become visible in absolute outline. This action of the cocaine was so entirely unexpected to me in the first case in which I observed it that I continued my observations in a number of cases, and in no single case, out of over forty observed carefully, has it failed to produce the same result. Every drop of blood was expelled from the erectile tissue in each case. The strength used was a two-per-cent. solution, and it was applied by means of a pledget of cotton wrapped on a small probe. The effect was usually observed in a few seconds, and the entire depletion of the sinuses of the whole cavity accomplished in about three minutes, the production of anæsthesia, as a rule, requiring a longer time."

Since writing the above my observations have been continued into many hundreds of applications, and the results are uniform,—the membrane is bleached almost. I formerly laid especial emphasis on the action of the cocaine

on the venous sinuses of the nasal cavity; a larger observation convinces me that the action is not only upon the venous sinuses but upon the capillaries and blood-vessels as well, with which it comes in contact.

In watching its effect upon mucous membranes, it has seemed to me that the true explanation of its action is that *it produces rigid contraction in unstriped muscular fibres* wherever it comes in contact with them. In this way we can understand how it completely empties the large venous sinuses of the nose, while it only diminishes the calibre of the capillaries and small blood-vessels, for in the intravenous spaces of the nasal mucous membrane are found large bundles of unstriped muscular fibres, which act in contraction not only on the periphery of the sinuses, but also to contract the membrane itself, and draw it down upon the turbinated bones. On the other hand, the contraction of the muscular fibres in the coats of the capillaries and blood-vessels, no matter how rigid, can only serve to diminish their calibre, without obliterating them, as is really the case with the erectile bodies.

That absolute contact with the muscle is necessary to produce this effect, and that the cocaine does not act through the nerve supply, is shown by the fact that the time required for the cocaine to act upon the blood-vessels is exactly proportionate to the absorptivity of the membrane, or, in other words, by the rapidity with which the membrane is penetrated by the solution. For it is a very noticeable fact that in children, whose mucous membranes are exceedingly delicate, and absorb remedies quickly, the action of the cocaine is strikingly rapid. I have frequently observed the venous sinuses in young children collapse in three or four seconds, while in adults the time required to produce the same result is often three or four minutes. Again, the effect of cocaine on mucous membranes covered with columnar epithelium is far more rapid than on those covered with squamous epithelium.

We have, then, in the cocaine a remedy upon which we may rely with absolute certainty of its action, that when applied in solution to the surface of a mucous membrane, it penetrates its

epithelial coat and reaching the coats of the blood-vessels produces rigid contraction of their muscular fibres, and thereby marked diminution in the calibre of the blood-vessels themselves. In our whole pharmacopœia we possess no other remedy, I think, which may be depended upon to accomplish this with certainty. We have used the various mineral and vegetable astringents for years, as topical agents, but I often think we do it in something of a tentative manner, and rarely with any great confidence of securing the result we desire. Certainly my own long and somewhat large experience in the treatment of throat affections has served to diminish my faith in the value of the ordinary local astringent applications to the mucous membrane of the upper air-passages.

If the prime factor or the first phenomenon of the inflammatory process be dilatation of the blood-vessels, from paralysis of their muscular fibres, we possess in cocaine a remedy which directly controls this feature of inflammation, and herein I think lies largely one of the valuable properties of the drug. Acting upon this view, that in cocaine we possess a topical agent which, if properly applied, will control an inflammatory process in the mucous membrane of the air-passages, I have made use of it in a very large number of cases—such as acute and chronic rhinitis, pharyngitis, laryngitis, tracheitis, bronchitis, asthma, etc.,—and in no single case have I failed to secure the anticipated result, provided that the drug was made to come in contact with the diseased part.

I have observed a large number of cases with reference to the duration of this action of the cocaine, and find that in the very large majority of cases the contraction of the venous sinuses persists about twelve hours, and oftener a longer time than a shorter one. This is the case if the drug has been thoroughly applied. In cases of acute inflammation of a mucous membrane the action on the capillaries, as a rule, persists for the same length of time, though in a few cases it has been only a few hours.

The contraction of the blood-vessels is always attended by a diminution of the mucous secretion.

I might add here that it is of importance that every

watery solution which is applied to the mucous membrane of the air-passages be of a decidedly alkaline reaction, and, therefore, finding that the cocaine solution at times seemed to cause irritation, I always add ten grains of sodium chloride to each ounce of the solution; furthermore, that in the clinical observations here recorded I have never found it necessary to use a solution stronger than two per cent. to secure its full local action.

Dr. F. H. Hooper[1] has made some very interesting observations on this action of the cocaine, which confirms fully the above noted views.

Dr. Cohen, however, writes me on Jan. 12, '85: "The effect on the turbinated mucous membrane I have noticed, but cannot accept your explanation. I hope, however, that it will now lead some of our brethren to recognize that these enlargements can be successfully treated by milder measures than the snare or cautery."

I add some notes on the morbid conditions in which I have found the local action of the cocaine valuable.

Hypertrophy of the nasal mucous membrane.—Perhaps no one morbid condition is found in the nasal cavity which demands treatment at our hands so frequently as this. The only rational and radical method of treatment is by destructive agents. Our usual experience has been that immediately upon the application of a caustic, a violent reaction sets in, the parts becoming actively turgescent, and the patient suffers from three to six days with a most violent "cold in the head." Since using the cocaine this reaction has been controlled in a large majority of cases, and whereas formerly my patients often left my office in a far worse condition than that in which they entered it, now it is always with relief, even after violent cauterization. We cannot only cauterize painlessly, but can do it without reaction, and so do it far more effectually.

Another and notable value of this action of the cocaine is as an aid to diagnosis in these cases of hypertrophy. As a rule, when we examine one of these cases there is a notable amount of turgescence of the sinuses, more or less completely

[1] *Boston Med. and Surg. Jour.*, Dec. 18, '84.

blocking up the passages. It is impossible to tell how much of this swelling is due to venous turgescence, and how much is due to hyperplasia. By means of the cocaine the element of turgescence is entirely eliminated, and we cannot only estimate the amount of hyperplasia, but can determine the point where the cauterization should be made.

Acute coryza.—The first stage of an acute coryza is turgescence of the blood-vessels, with diminution of secretion from the membrane. I have had an opportunity of making an application to two cases of this disease in the first stage. The cocaine was very thoroughly applied over the whole membrane, with the result of arresting or aborting the attack. Sajous,[1] writing on this subject, states that in his own case the effect of the first application lasted but twenty minutes. I have had no such experience, and think that he failed to thoroughly medicate the whole membrane. In the second stage of a cold, or the stage of secretion, I have treated quite a number of cases; in most of these cases the cold was broken up by a single application; some of them, however, required a second or third application. The relief lasted usually from twelve to twenty-four hours. When the trouble recurred it was always in a much milder form.

Nasal polypus.—In operating upon nasal polypi, one of the greatest difficulties that hampers the operation is the turgescence of the venous sinuses blocking up the passage and obstructing the view. This usually occurs as the result of the first introduction of an instrument into the cavity. By the use of cocaine this troublesome feature of the operation is entirely eliminated. The congestion of the blood-vessels is so thoroughly controlled that a clear view into the upper region of the nasal cavity is obtained, and even small growths recognized and removed. Furthermore, the troublesome hemorrhage which so ofter occurs during the operation is very markedly controlled. The bleeding is, I think, as a rule, from the venous sinuses, and these being rigidly contracted, this trouble is much diminished.

[1] *Medical News*, Phila., Dec. 20, '84.

Hay fever.—The morbid condition of the nasal mucous membrane in an exacerbation of this disease consists in a turgescence of the venous sinuses and blood-vessels, probably from a paresis of the vaso-motor nerves which are distributed to their coats. I have not been able to observe the action of the cocaine in an acute exacerbation of hay fever, but I have applied it in several cases in which the symptoms were present to a mild extent. In each case the result was the same, there was complete relief.

Sub-acute laryngitis.—In a number of cases of this disease, in which there was hoarseness or more or less complete loss of voice, a single application has resulted in a marked improvement to the tone of voice, which only partially relapsed at the end of twelve hours, or longer. In those cases in which cough was present, this was entirely arrested for from one to three hours. As is always the case in catarrhal laryngitis, there was a diseased condition in the nasal cavity, which was treated at the same time by the cocaine.

Acute bronchitis.—I have used the cocaine in several cases of acute bronchitis, or ordinary winter cold. In these cases there was a mild acute inflammation of the whole upper air-tract, extending from the nasal cavities to the pharynx, larynx, trachea, and larger bronchi. There was cough of a more or less distressing and persistent character, and a muco-purulent expectoration.

The only internal medication given in any of these cases was cubebs, either in the form of lozenges or mixed with glycerine. The plan of treatment was to make daily applications of a two-per-cent. solution to the nasal passages by the probe and cotton pellet, and to the pharynx and larynx by spray. In addition to this, inhalations of the cocaine were also given daily. A very fine atomizer was used (Delano's), and the spray thrown into a large glass-globe inhaler (Sass'), from which the patient inhaled deeply for about two minutes. In this way the coarser particles of the spray fell into the globe, while only the finer ones were carried into the trachea and large bronchi. I usually sprayed from four to six drachms of the solution, all of which except

from thirty to forty minims was subsequently poured back from the globe into my bottle. After the cocaine inhalation a short inhalation of fluid vaseline (the "Cosmoline," of E. F. Houghton & Co.) was given to allay any irritation which might be caused by the cocaine. The result was that in each case the cough was usually arrested for from one to three hours, and markedly relieved for the rest of the day. The colds were broken up in four or five days. It may be that these patients might have gotten well in as short a time by an ordinary cough mixture, but certainly at the time there could be no question as to the effect of the inhalations.

The following cases are added as affording many points of interest, and I think illustrating in a striking manner the local action of the cocaine.

A Case of Senile Bronchitis—Cure.

I was called on Nov. 30th to see Mrs. P., æt. seventy-seven, who had been suffering for a month with a violent cough. She had been taking various remedies with no relief. The cough was of a very harsh, racking character, coming on in paroxysms which lasted oftentimes a half hour or longer, and gave her little rest night or day. When I first saw her she seemed to be much worn and exhausted from loss of sleep and the violence of the cough. There was considerable wheezing with shortness of breath. An examination of her chest revealed the lower portion of each lung full of moist râles. There was also more or less sibilant and sonorous râles. The expectoration was of a bright yellow color and large in amount. The heart's action was weak, and the pulse intermittent and 100 to 110. She was of remarkably fine physique and had also a superior constitution, but her bronchial disorder was evidently telling very much on her. I determined to use the cocaine and therefore gave no medicine whatever. I feared somewhat to go too rapidly with her, being ignorant as to how much of the drug might be administered at her age and in her condition. Commencing with light applications to the nasal cavity, pharynx, and larynx, I found the action of the remedy to be absolutely neutral. It did neither harm nor good. On the fourth day I began giving inhalations in the manner described for acute bronchitis. I found that the relief given was marked, and the re-

sult was a quiet night's rest without coughing. The cough, however, began again in the morning,—the inhalation having been given at night. From that time I gave her inhalation night and morning until Dec. 20th. During this time an examination of the chest showed a marked and progressive improvement. The bronchial tubes cleared up, the shortness of breath improved, and the râles disappeared. On Dec. 20th an examination of the chest revealed no abnormal sign, and her cough had entirely disappeared.

It may be said in regard to this case that the inhalation could not have carried the remedy down to the lower air-passages. In inhaling she held the mouth-piece of the globe in her mouth, and every breath she took was charged with cocaine, which must have reached well down into the bronchial tubes. I feel confident that she was cured by the inhalations, and I think she could not have survived long had she not gotten this relief, and soon. It should be stated also that this was during the very trying weather which we had through the month of December.

This case was of especial interest as showing the actions of the cocaine in controlling the secretion of the bronchial mucous membrane, for not only was the improvement noted by ausculation, but the character of the expectoration changed from a muco-purulent to a healthy mucous discharge. The only explanation of this is in the action of the drug in controlling the blood supply, diminishing the calibre of the blood-vessels, and thereby lessening the mucous secretion and cell-proliferation.

A Case of Spasmodic Asthma.

Mrs. K., age thirty-seven, married, consulted me November 18, 1884, giving the following history: Since the age of twenty-five she had been a sufferer from asthma, with cough and expectoration; the paroxysms coming on usually at night or toward morning, and while they lasted being of a very severe character. Her attacks finally became so distressing that in 1877 she went to Colorado to live, where she was entirely well. Whenever she came East, however, her attacks returned. She left Colorado in October, and on her way her attacks commenced. She arrived in New York November 17th, and saw me on the following morning. She was suffering at that time very severely, the

attack having lasted eight days. On questioning her in regard to a nasal disorder, she acknowledged having some catarrh, but never associated it with her asthma, and was greatly surprised at my suggestion of a connection between the two affections. In Colorado she was free from asthma, but not from catarrh. She also remembered that her attacks were preceded by cold in the head, but had thought nothing of it. An examination showed her chest full of loud sibilant and sonorous râles with some finer moist mucous râles. In the nasal passages I found a marked deflection of the septum to the left, with enlarged right middle turbinated bone. There was also notable turgescence of the mucous membrane of the whole cavity, and as a result, marked stenosis.

I applied cocaine freely to each nasal cavity, which, by the way, was exceedingly sensitive, and in ten minutes her asthma had completely disappeared, and no râle could be heard in the chest. This relief lasted several hours, but at eleven o'clock the same night I saw her at her room. She was feeling uncomfortably, and feared her asthma was coming on. I applied the cocaine and she was completely relieved and passed the night with entire comfort.

I saw her daily from this time on, making applications of the cocaine, and at the same time treating the nasal disorder, which I was able to do without exciting any notable reaction, using caustics, the snare, etc. The improvement was very marked and most satisfactory. Occasionally she would feel somewhat oppressed from a particularly bad day, but was always relieved by the cocaine. After three weeks of treatment she was so well that she considered herself cured of her asthma, and was entirely free from it. Her nasal disorder, however, was not entirely cured, and she was coming to my office but twice each week. Early in January, during one of our exceedingly bad-weather days, she caught cold and had an attack of asthma. This was relieved, however, and with this exception she has been made entirely comfortable by the applications.

This case seems to present so many points of interest that it is my excuse for repeating it. She is not entirely cured of her liability to asthma, but the prognosis is very favorable; her nasal trouble, on which her asthma depends, is a curable one, and when that is cured her asthma is cured. Were nothing else accomplished than enabling her

to remain in the East this winter, submitting to daily applications of cocaine, it would be a great gain. For were she not relieved by the cocaine ; our pharmacopœia furnishes us with no remedy which could give relief. Opiates and anodynes she had used, and numberless other remedies, with most unsatisfactory results ; the cocaine gave her such relief as she had never before experienced, quickly, safely, and without disordering the digestive organs.

I have seen a very large number of cases of so-called nervous or spasmodic asthma, and in none have I failed to find some nasal disorder, the relief of which has given relief to the asthmatic trouble. I, therefore, in the above case had no hesitancy in assuring my patient that the temporary relief to the nasal turgescence would result in relief to her asthma, and hence, when I first saw her I made the application of the cocaine to the nasal cavity rather than to the bronchial tubes. The permanent cure of these cases can, of course, only be accomplished by removing the organic disease in the nasal passages.

Had the local application to the nares been ineffectual, I should have made the attempt to give inhalations of the cocaine, in the full faith of its giving relief, with the view that the morbid condition of her bronchial mucous membrane was essentially the same as that of her nasal passages.

In closing, I have only to add that I have endeavored to record my experiences with cocaine as a local therapeutic agent with absolute candor, and that I do not believe I have made a single claim for it which will not be confirmed by careful observation. Scarcely a patient has been in my office in the past two months and a half on whom the cocaine has not been used. In no single case where the drug was used to diminish the flood supply to a part, has it failed to do so, and this so promptly and so patently that I think I am fully justified in the assertion that our pharmacopœia contains no remedy so certain in its action, and few, if any, so valuable as a topical agent.

In using the cocaine as freely as I have done in giving inhalations, the question arose whether I might not be in danger of administering too large an amount. A very

careful observation on this point has failed to detect any symptoms whatever which would indicate that the drug had in any case acted upon the general system. I have also watched with some care for evidence of a reaction following the local use of cocaine. None has been observed; on the contrary, its action seems to be that of a tonic to the relaxed muscular fibres of the blood-vessels, for after the drug has ceased its action, and the coats of the blood-vessels relax, this relaxation does not, as a rule, reach to the extent of the former dilatation.

In several instances I have placed in the hands of my patients a two-per-cent. solution of the drug, with directions to make daily application with the Delano atomizer; in no instance have I discovered that it exercised any other than a purely local action. In one of these cases the applications have been made daily for six weeks. So far as our investigations have gone, therefore, I think we may safely assert that there is no danger of a "cocaine habit" being established.

In two cases the use of cocaine seemed to be followed by a violent headache. This came on about twelve hours after the drug was applied, or just at the time when its action was passing off. The headache lasted two or three hours, and was quite severe in character. My suspicion was excited that the headache might be the result of the cocaine application, but in no case did it occur from a second application of the drug. Moreover, no such reaction was observed in the very large number of other cases in which it was used.

COCAINE IN GENERAL SURGERY.

By R. J. HALL, M.D.

AS all the more-important published observations in this department have been already noticed in a previous portion of this paper, it only remains for me to add a few cases, not previously published, with some further experiments of my own on the subject, and to indicate the cases and the methods of using which promise the best results. Wherever an operative proccdure is limitcd to a mucous membrane and the incisions required are superficial, it will be sufficient to apply the cocaine by spray or brush, though this may not be in all cases the speediest or most convenient mcthod. Where, howevcr, the integument or the deeper parts are involved, hypodermic injections must be used, and my experience and observations, so far, indicate strongly that the only way in which rapid and reliable results can be obtained is by controlling thc nerve supply of the part in the way described in a previous communication by the writer (*N. Y. Med. Jour.*, Dec. 6, 1884). Thus, a number of physicians have told me that that they found cocaine of no value in the common and vcry painful operations upon the hands, such as incising felons, opening palmar abscesses, etc., yet these are among the very cases in which, properly applied, it seems likely to be most useful. My experience in the injection of the solution in the neighborhood of large nerve trunks has been almost limited to the branches of the trigeminus and the nerves supplying the hand. In the latter region I have succeeded, both in myself and in others, in producing complete insensibility of the parts supplied by the median, the radial, and the ulnar nerves.

The median can be found with great certainty as follows: The needle should be introduced about one third of an inch, at a level of about half an inch above the extremity of the styloid process of the radius, and close to the radial side of the tendon of the palmaris longus, the point being directed beneath this tendon; or, if the palmaris longus is absent, a quarter of an inch to the ulnar side of the flexor carpi radialis. The ulnar can of course be injected at the elbow between the olecranon and the internal condyle, but a few experiments lead me to believe that unless a rather large quantity is used, and the nerve actually pierced, the results are not very certain here, and it will probably be better to make the injection near the wrist, close to the radial side of the tendon of the flexor carpi ulnaris, anywhere between the styloid process of the ulna and two inches above it, introducing the needle about a third of an inch. If it is desired to include the dorsal branch of the ulnar, the higher point must be taken. There might seem to be some risk in making the injection here on account of the proximity of the ulnar artery, but once the skin is pierced, the needle passes so readily that the force necessary would not transfix the artery, and it can be further avoided by keeping close to the tendon. I have succeeded in affecting the radial by making the injection where it emerges from beneath the tendon of the supinator longus and just above the muscular belly of the extensor ossis metacarpi pollicis. Success here, however, seems rather less certain than in the case of the other two.

In the domain of the trigeminus I have had the opportunity to use cocaine twice for Dr. Sands, in operations for the removal of tumors of the floor of the mouth.

In the first case, which involved the removal of the right sublingual gland through the mouth, ℥ xvi. of a four-per-cent. solution were injected, the needle being introduced along the inner surface of the ramus of the inferior maxilla. After eight minutes no effect had been produced except a slight tingling along the side of the tongue. The needle, as I ascertained by later experiments, had been passed too far back; ℥ viii. injected by the side of the tongue had no

effect, and a few minutes later ♏ xvi. were again injected along the ramus, and in the usual time (three to six minutes) sensibility was almost abolished in the right half of the tongue, the floor of the mouth, and the posterior surface of the gums. Anæsthesia, however, was not absolute. The patient, a young man, then held his mouth open, and the tip of the tongue against the palate, while the tumor was excised by Dr. Sands with scissors and forceps, and the bleeding points secured. He winced occasionally during the operation, and afterward said that it had hurt him, but not very badly,—" not as much as pulling a tooth." Anæthesia was incomplete in this case obviously because the needle was passed too deeply.

The second case was as follows: slowly-growing epithelioma of the floor of the mouth occurring in a gentleman of about sixty. The tumor has been removed four or five times at irregular intervals, extending over a period of about five years. It now occupies the right side of the floor of the mouth, from the median line, extending along the posterior surface of the gums, on which it slightly encroaches, and about one inch backward. Before I saw the patient ♏ x. of a four-per-cent. solution had been injected into the floor of the mouth, posterior to the growth, without producing any effect; ♏ viii. were injected along the internal surface of the ramus of the jaw, passing the needle one half inch, and drawing it out a very little as the injection was made. In six minutes there was complete insensibility of the right side of the anterior portion of the tongue and floor of the mouth, with much diminished sensibility, but not complete anæsthesia of the posterior surface of the gums; ♏ x. were injected as before, but keeping a little closer to the bone. In two minutes there was complete anæsthesia of the right half of the tongue, the floor of the mouth, and posterior surface of the gums. (Whether the lower lip was affected, as it should be, or not, I did not ascertain in this case, but know from other experiments that when the injection is successful it is completely anæsthetized, exactly to the median line.) The epithelioma was then freely excised by Dr. Sands with the knife, and several

bleeding points tied. The posterior surface of the gums near the median line was scraped with a sharp spoon. During the operation, which was completed in fifteen minutes, the tongue was drawn up and to one side with sharp hooks. No pain was felt at all, except when a suspicious point on the *upper* surface of the gums, posteriorly, was scraped with a sharp spoon. The patient stated afterward that this was the only part of the operation which he felt. In this case, a few hours after the operation, some hemorrhage occurred from two small vessels, which had to be tied. The question naturally arose whether the cocaine, which renders mucous membranes anæmic, might not act as does the Esmarch bandage, and increase the oozing after the operation. I do not think, however, that this is the case. There was no general oozing, but hemorrhage from two distinct vessels. Moreover, in this and in a number of operations which I have performed with cocaine anæsthesia, the parts were not rendered anæmic, the bleeding during the operation was as free as would be expected, and there was never any special subsequent oozing.

In my previous paper, I mentioned the use of cocaine in **Dental Surgery.** Some additional practical points may be of value. Dr. Nash, who first employed it, at my suggestion, in this way, and has since used it quite extensively, thinks a curved needle convenient for reaching the inferior dental. Of course, when this is anæsthetized, all the lower teeth on that side are insensitive. It is a rather remarkable fact that an injection at the mental foramen will anæsthetize the two incisors and the canine, with the corresponding portion of the anterior surface of the gum, besides the half of the lower lip. A corresponding effect is produced in the upper jaw by an injection at the infra-orbital foramen; and in two cases a repetition of the injection here has caused almost complete anæsthesia of the two bicuspids and the corresponding portion of the gum. Some only partially successful experiments have convinced me that with a little practice it will be easy to reach the infra-orbital nerve from the mouth where it enters the infra-orbital canal. The needle should be passed almost an inch along the tuberosity

of the superior maxilla, the point being directed slightly backward and inward. Whether it will be found advisable to make such deep injections in such a region, merely for dental purposes, is of course doubtful, but it would undoubtedly be useful in operations on the superior maxilla, and perhaps also in severe trigeminal neuralgia, should the drug prove useful in these cases. In the few cases where I have tried it no harm has resulted. The nerve could undoubtedly be reached more easily by passing the needle along the external inferior angle of the orbit, but this would appear much more alarming to the patient. Twelve to fifteen minims of a four-per-cent. solution seems to be the amount generally necessary for a satisfactory result, unless the nerve is very small. The anæsthesia is usually complete in six minutes, and commences to disappear about fourteen minutes later. If the injection is repeated while the anæsthesia is at its height, the second result lasts longer,—in some cases, thirty-five to forty minutes,—and appears to last longer after each subsequent injection. In this way I have kept up complete anæsthesia of one half of the lower lip for over two hours, by the use of fifty minims in divided doses. This will be of importance in plastic operations on the face, and others which require some time. After these repeated injections there is, at least sometimes, markedly diminished sensibility of the part affected for from twenty-four to forty-eight hours. In this way it may possibly be of even permanent benefit in obstinate cases of neuralgia. Before leaving this part of the subject, I would suggest that it may be of value anatomically in mapping out areas of nerve distribution.

Where no large nerve-trunk can be found supplying the seat of operation, the principle can still be employed. It is only necessary to more or less completely surround the part, according to the directions from which its nerve supply is derived, by from three to five injections of about four minims each very superficially beneath the skin. Using it in this way, Dr. Halsted has operated successfully on four cases of **fistula in ano**, where quite extensive sinuses were opened up and scraped with the sharp spoon. In one case

sixty minims were injected in divided doses, with no other constitutional effects than the production of marked pallor. I have said nothing about the use of cocaine in general surgery, by its mere application to mucous, ulcerated, or raw surfaces, because in most cases the method suggests itself. We have applied it in this way, in the Roosevelt Hospital Out-door Department, to a number of cases of chancroid, before cauterizing with nitric acid, and with perfect success. Dr. Halsted has performed internal **urethrotomy,** after injecting the urethra with an ounce of the four-per-cent. solution. The patient stated that the operation did not hurt him as much as the passage of an ordinary sound. I have completely relieved the pain of an attack of inflamed and prolapsed **hemorrhoids,** by the introduction of a hollow suppository containing fifteen minims of the solution, and after a second suppositary three hours later the pain did not recur.

It remains for me to consider the **objections to the use of cocaine.** After an injection there remains for from twenty-four to thirty-six hours a soreness at the point where the needle was introduced, exactly like that of a rather severe bruise. This is not felt while the part is at rest, but only on pressure or muscular movement, and it is at worst but a trifling annoyance. The injection of fifteen minims usually causes no constitutional symptoms, but sometimes gives rise to dizziness, pallor, and dilatation of the pupil. A second dose of fifteen minims within ten minutes of the first generally produces slight symptoms if the patient is standing or sitting, but, as mentioned in one case above, much larger amounts are often borne, when the patient is lying down, without any thing more being observed than pallor and dilatation of the pupil. As Dr. Knapp has shown, much smaller amounts may cause unpleasant symptoms if rapidly carried into the circulation. After purposely producing dizziness and quite decided nausea in myself, by the injection of fifty minims of the four-per-cent. solution in rapidly repeated doses, the **dizziness** was completely and immediately **relieved,** and the nausea almost so, **by inhaling amyl nitrite,**—which suggested itself as a

probable physiological antidote,—until the face was slightly flushed. This did not interfere with the anæsthetic effects of the drug at all. Time and more extensive experience can, of course, alone enable us to decide whether its use, especially by the injection of nerve-trunks, is ever followed by any more permanent ill effects than those mentioned above.

USE OF COCAINE IN GENITO-URINARY AND MINOR SURGERY.

By E. L. KEYES, M.D.,

PROF. AT THE BELLEVUE HOSPITAL MEDICAL COLLEGE.

MY personal experience in the use of the hydrochlorate of cocaine relates to its employment in genito-urinary cases, in dermatology, in minor surgery. I have employed it in watery solution of two and four per cent., and as a six-per-cent. oleate. In the *urethra* my experience leads to the conclusion that the effect of the solution in abolishing sensibility is mainly confined to the surface of the canal, and that this effect is more marked in the anterior than in the deeper parts of the urethra.

If a four-per-cent. solution is painted several times over the meatus and near it upon the glans penis, and assisted by an injection of ten minims into the urethra, the latter being retained by compressing the meatus for a few minutes, meatotomy and the *division of a stricture near the orifice* with a straight bistoury may be accomplished sometimes without pain. Generally, if the cut is deep, a little pain is complained of, yet so little that it is unimportant.

By injecting twenty minims and retaining it in the same manner the instrument for *cutting strictures in the pendulous urethra* may be adjusted without pain, but I have not found, in several cases in which I have used the method, that the pain experienced during stretching the urethra preparatory to the final cut could be abolished. It is lessened undoubtedly, but not overcome, and the pain caused by the knife in the final cut is undoubtedly also lessened but not destroyed. The deeper the stricture from the

meatus the less positive has been the effect in my hands. I have in this manner performed *deep internal urethrotomy;* but as I have already stated, the success is decidedly less satisfactory than for cutting in the anterior segment of the canal.

I think it probable that this difference of result is due to the fact that the injected fluid, unless the quantity thrown in is considerable, naturally lies in the front part of the canal, being squeezed forward out of the deeper parts by the contractile urethral walls.

In cases of *irritable neck* of the bladder, where exploration was desirable I have not found as much advantage from the remedy as has been claimed by Dr. Otis in his report. To introduce the solution I have used the Ultzmann syringe and deposited about ten drops in the neck of the bladder and along the prostatic and membranous urethra. The advantage derived from this manœuvre has been in my hands very moderate.

One good effect in this region I can attest. In one patient I had occasion to inject the prostatic urethra with a strong solution of the nitrate of silver, about half a drachm to the ounce. I had done this several times, the effect being that the pain on making the injection was considerable and the frequency of urination and pain during the act very great for twenty-four hours. In this case I tried the cocaine, following it in five minutes with the nitrate-of-silver instillation at the usual strength. The pain on introducing the deep urethral syringe was not materially altered, the discomfort immediately attending the nitrate-of-silver application was as great as before, but no desire to urinate followed, and the subsequent urinary acts were not attended by the usual smarting pain. This result I considered satisfactory.

I have not injected cocaine into the bladder, but I have employed it in deep urethral injection for sub-acute *gonorrhœal cystitis* without any apparent effect.

For the urethra, then, my experience leads me to conclude that the agent in question is valuable for catheterization, sounding, explorations, etc., particularly in the front

parts of the urethra, less so as we progress more deeply in the canal; but that some effect is obtained throughout. Doubtless with stronger solutions used in larger quantity more satisfactory results may be attained.

Preparatory to making *cauterizations for mucous patches, venereal ulcers*, and the like, *removing warts*, *excising chancres* and *small growths* upon the penis, the cocaine solution is very valuable in relieving pain, but the effect is not uniformly great upon all subjects, yet it has been obvious in all where I have tried it.

About the mouth, nose, and throat the same remark holds good.

In spraying ten minims of a four-per-cent solution into the throat of a gentleman on several occasions, I have noticed that the patient sometimes complained of a sense of constriction about the muscles of the throat, a choking sensation with tendency to swallow and cough, quite disagreeable and lasting several minutes, attended by dizziness, followed slowly by exhilaration and then a sensation of considerable comfort, with anæsthesia.

Using the drug subcutaneously, ten to twenty minims of the four-per-cent. solution, I have removed a great number of wens, warts, moles, lipomata, fibromata, etc., with a uniform result. No pain was experienced in the cutting, tying vessels, sponging the raw wound, applying the sutures, unless the operation was prolonged, in which case sensibility gradually returned.

In one case I performed *circumcision* in an adult, injecting twenty minims of a four-per-cent. solution into the redundant prepuce, and when the cutaneous sensibility had been abolished, cutting away the prepuce with its enclosed injection. The result was not satisfactory. The injected cellular tissue seemed redundant, and made accurate coaptation of the cut surfaces more troublesome than is usual, and the effect of the injection was not maintained long enough, so that the final application of the sutures was perhaps as painful as if nothing had been used. The case did well.

I was much gratified with the result obtained in cutting

out a small ulcer which I believed to be an *epithelioma at the margin of the anus.* I injected about ten minims of the four-per-cent. solution under the ulcer, stretched the sphincter with a speculum, distending to a circumference of about six inches, and excised the ulcer and a few fibres of the underlying muscle quickly—with pain, it is true, but a pain easily tolerated, and not causing the patient to shrink or pull away from the instruments either during the operation or the subsequent manipulations to arrest hemorrhage.

Two of my cases did badly: one, a broken-down hospital patient, had considerable suppuration follow the removal of a lipoma, as large as an almond in the shell, from his forearm; and in another case, that of a medical student apparently healthy, diffuse suppuration of the forearm, with mild lymphangitis and the subsequent formation of many small cutaneous abscesses in the neighborhood, followed the ablatin of a small wart, a third of an inch in diameter, under which I injected five minims of the four-per-cent. solution. That the cocaine was at fault in this case I cannot affirm.

The six-per-cent. oleate I have used with temporary advantage (but no permanent effect) in relieving *anal pruritus* and the itching of eczema.

I believe that in cocaine we have an agent of great present value and of much future promise.

Appendix.—Dr. T. N. Otis kindly permitted me to insert the following statement, taken from a letter, into this pamphlet:

"I think that an important point is in the necessity which I have found of waiting fully fifteen or twenty minutes after the introduction of the cocaine before attempting operative procedures. To-day, in a rare case of spasm in the penile urethra, at two and a half to four inches from the orifice, the spasm did not give way until twenty minutes after the introduction of a four-per-cent. watery solution, and then only after the glans had become shrivelled and cold. Up to that time only a No. 4 French bougie could be passed; after that a No. 28 was passed, and withdrawn without holding. [H. K.]

COCAINE IN GYNECOLOGY AND OBSTETRICS.

By W. M. POLK, M.D.,

PROFESSOR OF OBSTETRICS AND GYNECOLOGY IN THE MEDICAL DEPARTMENT OF THE UNIVERSITY OF THE CITY OF NEW YORK.

THAT this remedy may be of service in a number of the operations upon the female genital tract is shown by its action in the few in which it has been tried.

The results obtained in the operations upon the cervix are quite satisfactory. The normal sensitiveness of this portion of the uterus being less than that of most of the tract, we have a tissue that can be readily influenced by the drug. Consequently, trachelorrhaphy, incision of the cervix, forcible dilatation, the application of caustics or the sharp curette to the cervical surface, have all been satisfactorily performed under the influence of cocaine. Even in cases of commencing cancerous disease, we have been able to make a free application of the actual cautery, causing but trivial discomfort; the well-known danger of the general anæsthetics—even ether—in advanced cancerous cachexia making the use of this remedy in such cases peculiarly attractive. The method of application that seems best in preparing the cervix for operation, is to inject from three to five minims of a four-per-cent. solution into the regions that are to be cut, stretched, or scraped.

In all cases where, from the use of the Sims speculum, prolonged stretching of the perineum is to be endured, the whole of the posterior and lower half of the vagina should be thoroughly painted.

In operations upon the vagina we meet with more diffi-

culty, owing to the greater sensitiveness of the tissue; still by careful injections into the region to be cut we have made satisfactory operations.

The most striking results were obtained in *small* vesico-vaginal fistulæ. Here the remedy (four minim of a four-per-cent. solution) was injected first on one side of the fistula,—half an inch away,—then on the other. Next the mucous membranes of the vagina and the bladder around the opening were freely painted with the solution. The tissues were then cut without discomfort. Operations for restoration of the perineum were less satisfactory, the sensitiveness of this region being perhaps more pronounced than in other regions of the tract. Our observations, however, have led us to believe that in certain cases where the lesser forms of perineal rupture are found, the remedy could be made to answer a useful purpose. Certainly, in the removal of wire stitches from the perineum, a procedure that is usually very painful, the results have been satisfactory. The best method of applying the remedy in all operations about the perineum is to inject four or five minims of a four-per-cent. solution into the two sides of the vagina, just within the ostium, and then carefully rub the same solution into the skin and pseudo-mucous membrane which covers, first the perineal region and lower end of the labia majora, the second, the faces of the torn perineum and the inner faces of the labia; lastly, freely applying it to the whole of the lower third of the posterior and lateral vaginal walls. In all of these surface applications the tissue should first be carefully cleansed with soap and water and then dried.

In the removal of urethral caruncles, bodies well-known to be more than usually sensitive, we have operated with the cautery without pain, first injecting into the tumor four minims of a four-per-cent. solution.

In like manner we have cauterized painlessly chancroids and chancres, securing the anæsthesia in such cases by merely painting over the sore some half a dozen times with the four-per-cent. solution.

In estimating the value of cocaine in gynecology, it

should be understood that its field is limited. There are many women who are too sensitive, too apprehensive, to be kept quiet during a protracted operation by any thing short of general anæsthesia.

In general it may be stated that in the lesser operations, and even in those that require time, when the subject is phlegmatic and endowed with self-control, cocaine will prove satisfactory.

IN OBSTETRICS.

Naturally attention was early directed to the possibilities of the remedy in obstetrics. A good article of cocaine was furnished Dr. Le Fevre, the House Physician of the Second Medical Division, Bellevue Hospital, and he was directed to try its efficacy in various stages of labor. During the first stage of labor injections of four minims of the four-per-cent. solution were made into the anterior and posterior lips, at the vaginal junction. Complete anæsthesia of the cervix was obtained for an hour, during which time the labor pains were so modified that the patients complained only of discomfort above the symphysis pubis and some dull pain over the sacrum. The cervix could be stretched freely without causing pain, so that it was quite evident that decided relief had been obtained. An effort was made to secure the same result by merely painting the solution over the cervix, but owing to the profuse mucous discharge this application was difficult and the results unsatisfactory.

To modify the pains of the second stage, injections were made into the vaginal walls along the course of distribution of the pudic nerves. In this the results were so far successful that the child's head passed out of the vagina with so little discomfort that the patient uttered no complaint. Careful observation of all the children of these cases showed no ill effect of the remedy. When rupture of the perineum occurred, the remedy was injected into the torn surfaces and rubbed on the skin. In this way sufficient anæsthesia was obtained to permit of the easy passing of

sutures for repair. During labor cocaine seems to possess no special advantages over chloroform, unless it be in those cases where this remedy is contra-indicated.

In cases requiring dilatation of the cervix, as by Barnes dilators, it may prove of great service. In one case of troublesome nausea and vomiting of pregnancy, Dr. Le Fevre found an eroded and sensitive os as the cause. Careful painting of the surface with a four-per-cent. solution of cocaine gave entire relief from the gastric disturbance. Excellent results were likewise obtained in cases of nursing women who had painful and eroded nipples. The four-per-cent. solution was freely applied to the nipples, fifteen minutes before nursing, then washed off with warm water just before applying the child. In all these cases the dreadful and wearing pain was either entirely relieved, or else so modified as to be quite bearable. And here we may say that if obstetrics derived no other benefit from cocaine than this, we would have sufficient ground for hearty commendation.

IN GENERAL SURGERY.

How far cocaine will prove beneficial here cannot be said, but as a contribution to the subject we will give the results obtained in a case of hepatotomy performed some weeks ago.

The patient was a man of seventy-two years of age, who, for four years, had been suffering from an hydatid tumor of the liver, which touched the abdominal wall in the region of the gall bladder. Two months ago it began to suppurate, which led to such enormous distension as to threaten the patient's life, as much from pressure as from other causes inherent to it. It was evident that the cyst must be evacuated, and that too by a free incision.

The condition of the patient was such that the effects of any general anæsthetic were greatly feared. Therefore it was determined to perform the operation under the effects of cocaine. The skin over the tumor was carefully cleansed with soap and water, and then the four-per-cent. solution was rubbed in for half an hour. Prof. J. Williston Wright, Dr. Stone, and Dr. Ashton assisting, we then made the incision. The skin and subcutaneous fat were passed with trivial pain. Reaching the muscles we found

such sensitiveness as to necessitate the use of the cocaine. In five minutes after a free application we passed without pain to the peritoneum. This proved the most sensitive of all the tissue we encountered, but a free application of the remedy speedily anæsthetized it, so that we cut through it without pain. Contrary to expectation, no adhesions were found between the tumor and the abdominal wall, but its tissue was so little sensitive, a few minutes' application of the cocaine prepared it for incision. Partially emptying the sac with an aspirator, its walls were seized and held against the abdominal incision while we made a free opening. Passing in the fingers we stitched the edges of the cut in the tumor to the wound in the abdominal wall. As many as eight sutures were thus placed, each being passed through all the layers of the abdominal wall, thence into the sac. This was done without the slightest pain to the patient. Next the sac was emptied and washed out, one gallon of pus and broken down hydatids being removed. Then the usual dressing was applied. A careful examination of the patient, made by all the gentlemen present, showed that his condition was much better than when the operation began. At no time did any symptom of shock occur, and certainly the condition in which the completed operation found him (it lasted nearly an hour) was far better than it would have been had any general anæsthetic been used. To complete here the record of the case, I will say that no peritonitis occurred. Constant improvement marked its progress until about the tenth day, when, with a normal pulse and temperature, he showed a distaste for food. This increased, and finally on the twenty-second day after the operation he died. The cause of death was apparently pure inanition, due to failing digestion, consequent upon the complete absence of bile from the alimentary canal. Soon after eating, the flow of bile from the sac was very great, continuing for about twenty minutes, then gradually ceasing. This continued so long as he took food. The action of the bile as an antiseptic was shown by the absence of odor and decomposition in the sac and about the wound.

Autopsy showed no peritonitis, an atrophied left lobe of the liver, and an old rupture of the bile duct, coming from the right lobe, the point of division being just at the junction with the common duct, so that ninety-five per cent. of all the bile secreted was poured out at the abdominal wound. Had the patient been younger he might have combated this abnormality longer, but his age rendered the defect speedily fatal.

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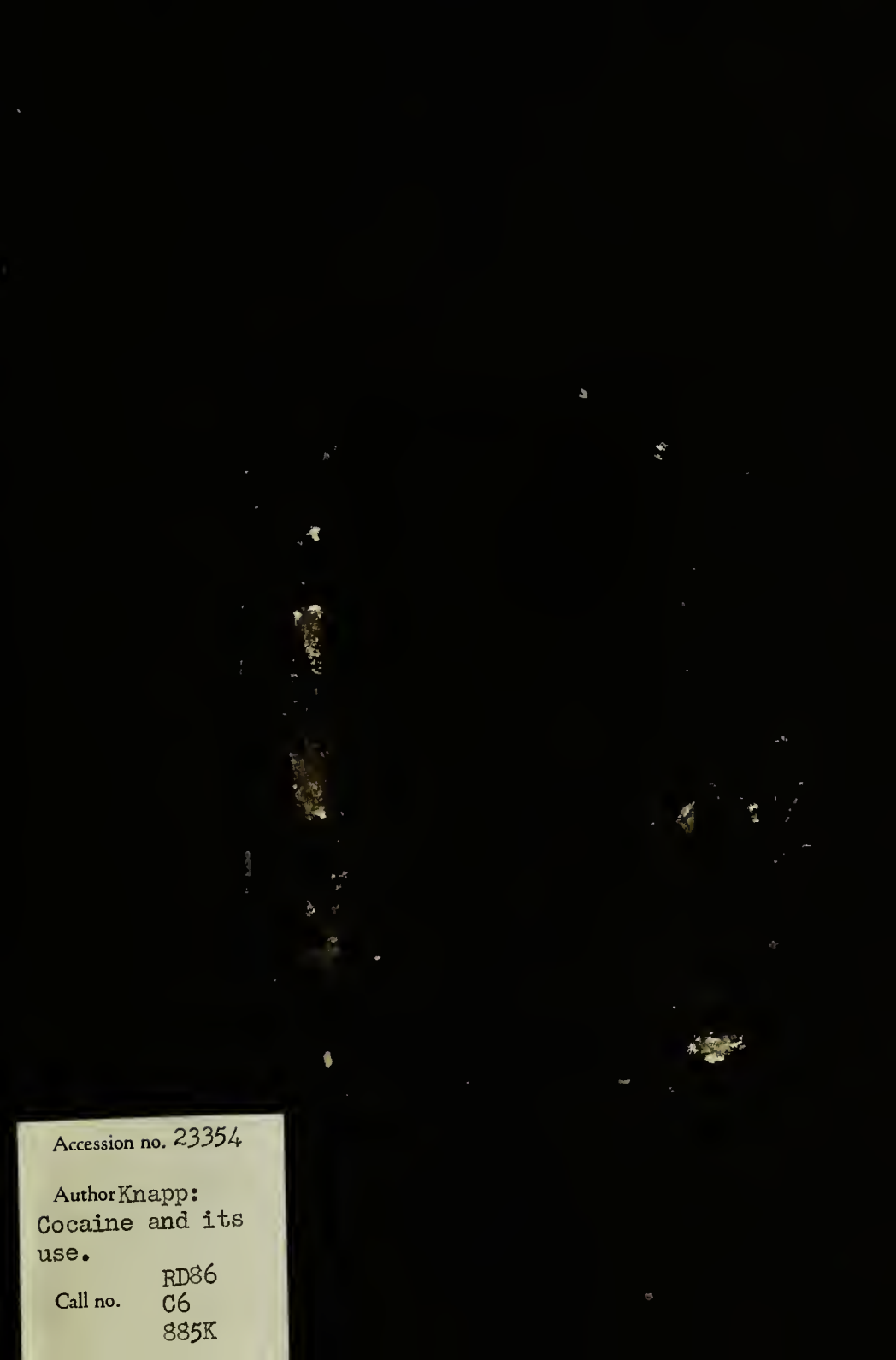

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